A TREATISE ON COMPARATIVE ANATOMY.

BY

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WITH

Conſiderable IMPROVEMENTS and ADDITIONS, By other Hands.

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TO THE

PRESIDENTS,

AND

THE OTHER MEMBERS,

OF THE

ROYAL MEDICAL SOCIETY

OF EDINBURGH:

This Edition of

The late Dr Monro's Treatise on

COMPARATIVE ANATOMY,

is,

WITH THE GREATEST RESPECT,

DEDICATED,

By their very humble servant;

EDIN. Jan. 13. 1783.

CHARLES ELLIOT.

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PRE-

PREFACE.

WHAT is called *Comparative Anatomy*, was certainly the firſt branch of the ſcience that was cultivated; and from it the earlieſt anatomiſts formed their notions and ſyſtem of the human body. The natural prejudices of mankind, and, in ſome ſenſe, common humanity, oppoſed any attempts to be made in the other way. As the firſt phyſicians were philoſophers, and this part of natural knowledge more immediately related to medicine, they particularly applied to it. Democritus, who, according to ſome, was the maſter of Hippocrates, ſpent much time in diſſecting brutes and examining their ſeveral parts. He applied himſelf with ſuch eagerneſs to this ſtudy, as to incur the cenſure of madneſs. His deſign was to examine the nature of the bile, and learn the ſeat and cauſes of diſeaſes. That this ſcience was much improved by the times of Hippocrates, is very apparent from his writings, which are intermixed with reaſonings drawn from it; and ſome parts of his phyſiology are only applicable to brutes. Theſe paſſages appear to us exceeding obſcure, often falſe and contradictory; and have for that reaſon been rejected by ſome very great critics. But is not this owing to our own ignorance? We do not well underſtand the then received ſyſtem of anatomy, and his terms and names do not correſpond to ours. The ſmall tract *De Vulneribus Capitis*, is as great a maſter-piece in its kind as the *Coacæ Prædictiones*. Yet the firſt has been eſteemed by ſome lame and imperfect, and afforded occaſion for many diſputes and wranglings; and all this becauſe not underſtood. Anatomiſts, however, have done by Hippocrates in moſt caſes as the critics with Homer, made him the maſter of all human and divine ſcience. Not a new diviſion of a bone, or diſpute about a proceſs or articulation, but has been referred to his judgment; and he has often been made to explain what he never dreamt of. Galen, the father of anatomiſts, is, for the ſame reaſon, in many places, become an obſcure writer. He is accuſed and defended by the greateſt ſucceeding maſters. Veſalius, the great reſtorer of anatomy, will not allow accuracy or truth in many of his deſcriptions; they are, according to him, taken from brutes, and obtruded on the world for human.

The other anatomiſts treat Veſalius much in the ſame

manner; and, with uncommon ſagacity and unwearied application, have found out variations and *luſus naturæ* in particular parts, that they may eſtabliſh Galen's deſcriptions, and condemn thoſe of Veſalius. This is particularly the caſe with Euſtachius in his Treatiſe on the Kidneys. How ſhall we now underſtand Galen, and judge between theſe great anatomiſts? It is Comparative Anatomy alone can extricate us from this confuſion; as it will teach us when Galen and others deſcribed and reaſoned from brutes, and when not. We ſhall then find, that the greateſt part of his deſcriptions was taken from brutes, which he transferred by analogy to the human body, and ſo are inaccurate; that a few were taken from the human ſubject, and are not capable of being otherwiſe applied. This ſtudy he himſelf recommends with great earneſtneſs to his ſcholars; and it is obſervable, that the moſt eminent anatomiſts firſt diſcovered their genius by an early attachment to it. This was particularly the caſe of Veſalius and Valſalva †.

As the firſt knowledge the ancients gained in anatomy was from the diſſection of brutes, ſo they formed the names and terms of art from the moſt natural appearance the part afforded, and that in different animals. Thoſe names were applied to the correſponding parts in the human body, and retained by ſucceeding anatomiſts to avoid a multiplicity of words. This, however, produces one bad effect, that it muſt miſlead us in our conceptions, as thoſe names are often very improper epithets in the human ſubject. The author has elegantly remarked ſeveral of theſe. The name of *right* and *left* ventricle is apt to give a wrong idea of the poſition of the heart; and the aorta *aſcendens* and *deſcendens* has impoſed on ſome of the maſters in anatomy, who, it is plain, have taken their figures from the name. Diſputes have ariſen about the *appendix vermiformis*, &c. which are all cleared up when we once view the part in the animal whence the name was taken.

The intention of nature in the formation of the different

† Gaudebat enim avicularum, aliorumque animalculorum diſſectionibus; eorumque exta curioſus, quam pro illa ætate, rimabatur: quam ego præſignificationem, non in Veſalio tantum, ſed in aliis quoque pueris fuiſſe ſcio, qui, cum adoleviſſent, anatomiæ penitus ſe dediderunt. *Morgagni Comment. de vita Valſalvæ.*

ferent parts, can nowhere be ſo well learned as from this ſcience; that is, if we would underſtand phyſiology, and reaſon on the functions in the animal-œconomy, we muſt ſee how the ſame end is brought about in other ſpecies. We muſt contemplate the part or organ in different animals, its ſhape, poſition, connection with the other parts, &c. and obſerve what thence ariſes. If we find one common effect conſtantly produced, tho' in a very different way, then we may ſafely conclude that this is the uſe or function of the part: this reaſoning can never betray us, if we are but ſure of the facts. The writers in phyſiology have generally taken another route, and one favourite theſis or other ſerves to explain the whole or moſt of the ſyſtem. An innate and concocting heat, acids, menſtruums, &c. have all had their ſucceſſive reigns and patrons: and in truth, phyſicians ſeem not to have ſufficiently conſidered the importance of this ſtudy to form a complete phyſiology, which muſt ever be the great baſis of their art. They have beſtowed pains in examining the human body, diſſected minutely its ſeveral parts, traced out (perhaps often invented) a new diviſion of a muſcle: But how little has phyſic been promoted by all this? The moſt accurate deſcription of the human ſtomach, with all its veins, arteries, nerves, &c. will never rightly explain digeſtion. What muſt we then do? Examine it in the other ſpecies of animals, mark there its differences and the effects, compare theſe with the human; and then ſhall we, in ſome meaſure, be able to judge what are the principal inſtruments, and how they are employed in this compound action. Any other way of reaſoning (as the author well obſerves) will never bring us to the ſolution of a philoſophical or medical problem. It muſt indeed be confeſſed, that this method is tedious and ſlow; many obſervations muſt firſt be made, and the labour of ſearching and examining gone through, before we can have proper materials to build on. Yet theſe are the hard conditions on which the knowledge of natural cauſes is to be obtained; which, as a great genius ſays, *Tam facile ſolertia vincî poſſunt, quam ſolent conatibus vulgaribus difficulter evdere.*

Of this kind of reaſoning we have many beautiful inſtances in the following papers. Such is the account of the poſition of the Duodenum; of the cauſe of our pre-

ferring the Right Arm; of the circulation of the blood in the Fœtus; the hiſtory of the Thymus and Thyreoid Glands, their uſe and mutual proportion; the uſe of the Spleen, &c. This laſt he explains in ſo ſhort and maſterly a manner, that more argument will be found in the few lines upon it, than is to be collected from whole treatiſes on the ſubject. But as his deſign was to give a deſcription of the ſeveral ſpecies, or rather their principal differences, he chiefly confines himſelf to this. So in the anatomy of the dog he compares the different poſition, ſhape, length, &c. of the ſeveral parts with the correſponding parts in man; and from that one circumſtance, the difference of an erect and horizontal poſture, explains all the variations. This reaſoning then gives ſolution to many difficulties in the human anatomy; why the Spleen is ſo firmly attached to the Diaphragm; why the Omentum reaches only ſo far; why the poſterior part of the Bladder is only covered by the Peritoneum, &c. There have been diſputes about the fiſſure in the human liver, and different accounts given. Theſe all vaniſh, when we conſider this viſcus in different animals. We then find, that there are more or fewer diviſions, according to the greater or leſſer flexility of the ſpine. The ſame rule holds with regard to the diviſions of the lungs. This reaſoning likewiſe excludes the pretended uſe of the ligament in the human liver. And, in ſhort, we can underſtand but little of our own ſtructure unleſs we ſtudy that of other animals: we ſhall then find, that the ſeveral variations are relative, and depend on the different way of life; that is, one leading ſpecialty draws after it a great many more, in which nature is always an œconomiſt, and takes the ſhorteſt route.

The beautiful gradation of nature in the different orders of beings is very remarkable, and ſtrikes the mind firſt as being moſt obvious; but when we take any one ſpecies, the caſe there is ſtill the ſame, and we obſerve as ſurpriſing a difference. Thus, in the animal kingdom, ſome are provided with lungs, when others are deprived of theſe breathing organs; ſome have a muſcular diaphragm and ſtrong abdominal muſcles, others a mere membrane. It muſt be very entertaining to learn how theſe differences and deficiences are adjuſted and ſupplied: it is then from this ſcience alone we can underſtand

derſtand that ſimplicity of nature which is ſo much talked of, and but little underſtood. Hence likewiſe we muſt learn what to think of animals perfect and imperfect.

Anatomiſts have made a noiſe about the different ſtructures of the ſame part in the human body, and been at great pains to make collections of thoſe *Luſus Naturæ*, as they call them; which becauſe they are rare, are for that very reaſon of no great conſequence to be known. The epithet, however, is extremely proper; for the moſt remarkable of them are tranſitions from the order or law of nature that obtains in one ſpecies to that of another. Thus it has been obſerved, (tho' very rarely), that the liver was ſituated in the left hypochondrium: but, as our author remarks, it is not peculiar to it to lie on the right ſide in animals; for in fowls it lies equally in both, and in fiſhes moſtly on the left.

It is ſurpriſing that we have no tolerable treatiſe on this ſubject, which is in itſelf ſo entertaining and ſo conducive to promote Medicine. Thoſe who have made attempts this way, have only collected and ranged in order ſome particular ſpecies, ſuch as Birds or Fiſhes. They have likewiſe with great labour given us figures and deſcriptions of them; but all this is little elſe than mere amuſement. It is the ſtructure of their internal organs we ſeek after, and the manner how the different functions of the animal-œconomy are performed. Their hiſtories of theſe are every way defective and erroneous. There are indeed noble hints to be found in the writings of ſome of our modern anatomiſts, particularly thoſe of the immortal Dr Harvey. That great man well underſtood the importance of this ſcience to advance medicine; and accordingly employed the moſt of his time in diſſecting animals of different tribes, and making experiments on them: by which means he made the greateſt diſcovery that ever was in the ſcience, and laid the foundation of the preſent ſyſtem. He had certainly left us other treatiſes on this ſubject, had he not been interrupted by the civil wars. The phyſicians who lived then, imitating his example, made many new experiments on the bodies of brutes, changing their juices by tranſuſing of new liquors, accurately marking the effects, &c. that all this might be transferred to the human body: And indeed, from the application of theſe reaſonings to

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the obſervations they made on morbid bodies, the ſcience ſeemed faſt advancing to that phyſical certainty which can be attained from experiment and obſervation. But, alas! this ſpirit died with thoſe great men, and theory and calculation came in its place. Mathematics, it was ſaid, could alone bring the ſcience to certainty, and throw out conjecture. The quantity and velocity of the blood, the force of the heart, diameters of the veſſels, &c. were ſubjected to meaſure and number, and diſeaſes next were to be accounted for, all in a mathematical manner.—This method, however, did not ſucceed according to wiſh: For, firſt, thoſe great geniuſes diſagreed widely in their calculations, and differed from one another; whence, in place of certain concluſions, we had only wranglings and diſputes: not to mention, that ſome of them made ſuch eſtimates as muſt plainly appear ridiculous at firſt ſight *. This, ſome may ſay, proves nothing; it was the fault of the artiſts, who aſſumed wrong hypotheſes for their calculations, or were not perhaps accurate enough in their obſervations. True; but whoſe fault was it to adapt figure and number to a ſubject which refuſes them, through its numberleſs deviations from fixed laws and conditions?—Is an animate body a mere bundle of hard conical elaſtic tubes, and the heart a pump forcing the liquors through? Are then all the veſſels exact cones, or have any two anatomiſts agreed in their meaſures of them? Do they not yield every way? and are they not continually obſtructed in different places? Are there not many different attractions prevailing for the ſeveral ſecretions, and many different forces acting on the veſſels at the ſame time, which can never be determined? &c. Theſe and ſuch like conſide-

rations

* The ingenious Dr. Pitcairn was the chief man in theſe parts who gave into this way. He ſuppoſes the force of the muſcles to be in a compound ratio of their length, breadth, and depth; that is, as they are homogeneous ſolids in the ratio of their weights. Whence knowing the force of any one muſcle, we can by the rule of Proportion (from their weights) determine that of another. This he applies to the ſtomach; and by the computation its muſcular force at leaſt is equal to 227080 lb. weight.—That muſcles are in that proportion, is a mere hypotheſis, for which the Doctor does not offer the ſmalleſt proof; and had he aſſigned five ounces as the weight of the ſtomach, he had been nearer the truth. This is one glaring inſtance how much theory and whim may prevail with the greateſt of men over common ſenſe.

rations will ſoon convince us how little the practice of medicine is to be promoted by thoſe ſpeculations *. If theſe gentlemen meant by mathematical reaſoning phyſical experiments, then no one ever doubted of this, no more than they do of the uſe of mathematics in natural philoſophy itſelf. But as this ſeems not to be their ſenſe of the matter, they ſhould point out a few diſeaſes which this ſcience has explained, and wherein it has corrected the received practice.—But we are now got from the ſubject to what is foreign. To return then: Comparative Anatomy has hitherto been treated but by pieces. Thus ſome, writing on the human eye, have examined the eyes of other animals; and ſo with regard to the heart, &c. Some have given us the deſcription of one particular animal, others of another. But no one author, that we know of, has given us a ſyſtem of this ſcience, where we might have a ſummary view of the moſt material differences in the ſtructure of animals. There are indeed compends of this ſcience, if you will, which are eſteemed by many, and were wrote with the noble deſign of illuſtrating the wiſdom and goodneſs of our Maker. But thoſe who compoſed them were not anatomiſts themſelves; ſo could only collect from others, which they often do without any judgment: for how voluminous ſoever their works may be, yet if you will ſtrip them of their repeated exclamations, citations of authors and books, the many ſtrange and ſurpriſing ſtories, all told, however, by creditable vouchers, you will have little left behind beſides an indigeſted chaos of hiſtories and deſcriptions, ſome true and many falſe. The argument, however, was popular, and they could not fail of pleaſing.

The following Treatiſe, by the late celebrated Dr Monro, is executed upon a more uſeful plan, and in a more ſyſtematic manner. The deſcriptions are all taken from

* The authority of Hippocrates is often adduced in this argument; for which they cite two paſſages. In the one he recommends the ſtudy of Aſtronomy as neceſſary to a phyſician; and in the other, that of Arithmetic and Geometry.——The firſt he did from his belief in the influence of the ſtars; and the ſecond from his veneration for the Pythagoric numbers, in the myſteries of which he founded his theory of the criſes in acute diſeaſes: Both theſe conſiderations then are foreign to the purpoſe, nor is there in any of his genuine writings the ſmalleſt veſtige of this kind of reaſoning. On the contrary, Celſus ſays of him, *Primus ab ſtudio ſapientiæ medicinam ſeparavit.*

from the life, and the reaſoning employed is plain and concluſive. Theſe are intermixed with many practical obſervations in medicine and ſurgery, which muſt equally inſtruct and entertain the reader.

This work, in ſubſtance, appeared about forty years ago, under the title of *An Eſſay on Comparative Anatomy*; but without any author's name, being only compoſed from Notes taken by a ſtudent at the Claſs Lectures. As it was of courſe exceedingly defective and erroneous, the preſent Profeſſor of Anatomy, in preparing for the preſs the Collection of his father's Works lately publiſhed, corrected this piece amongſt the reſt; and alſo made ſome additions to it, from obſervations that had been collected by the author with a view to a larger work upon the ſubject, but which various avocations prevented him from proſecuting. The Profeſſor's deſign, however, being only to correct his father's works, not to enlarge them by additions of his own, the preſent performance ſtill remained leſs complete than might be wiſhed, and unimproved by later diſcoveries. It having been, therefore, ſuggeſted to the preſent publiſher, as proprietor of the late Doctor's Works, that a ſeparate Edition of this Treatiſe, improved and enlarged, could not fail of being acceptable, he readily adopted the deſign; and was fortunate enough to prevail with ſome gentlemen verſed in the ſubject to undertake the taſk of making the neceſſary additions and improvements. This has been accordingly accompliſhed, as far as the limits of a compend would admit, or as ſeemed to comport with the original ſcale of the undertaking. Some of the principal ſubjects, particularly the Dog, Fowls, and Fiſhes, have received conſiderable augmentation: Others have been entirely added; as Amphibious Animals, Serpents, Inſects, &c.; And leſſer additions in great number have been made in various parts of the work,—either inſerted into the body, or thrown to the bottom of the page in the form of notes. Of the additions in general, a few are drawn from the experience and obſervation of the gentlemen themſelves who had the care of the edition, ſome from different parts of the late Author's other Works, and the greateſt number from the Lectures of the illuſtrious Profeſſor who now fills the Anatomical Chair.—To render the whole more uſeful, an Alphabetical Index of the principal matters is ſubjoined.

AN ESSAY ON COMPARATIVE ANATOMY.

The INTRODUCTION.

THE principal advantages of Comparative Anatomy are the following. First, It furniſhes us with a ſufficient knowledge of the different parts of animals, to prevent our being impoſed upon by ſuch authors as have delineated and deſcribed ſeveral parts from brutes as belonging to the human body. Secondly, It helps us to underſtand ſeveral paſſages in the ancient writers in medicine, who have taken many of their deſcriptions from brutes, and reaſoned from them: their reaſonings have often been miſapplied (and conſequently wrong explained) by the moderns, through a fooliſh fondneſs to ſupport their own inventions, or give an air of antiquity to a favourite hypotheſis. The third and great uſe we reap from this ſcience, is the light it caſts on ſeveral functions in the human œconomy, about which there have been ſo many diſputes among anatomiſts: Theſe will be in a great meaſure cleared up by exhibiting the ſtructure of the ſame parts in different animals, and comparing the ſeveral or-

gans employed in performing the ſame action, which in the human body is brought about by one more complex.

In this view, it is altogether needleſs to inſiſt on thoſe parts whoſe uſe is eaſily underſtood when once their ſtructure is unravelled. Thus, for inſtance, if we be acquainted with the action of the muſcles in general, it will not be difficult to determine the uſe of any particular muſcle whoſe origin and inſertion is known, if we at the ſame time conſider the various connections of the bones to which it is fixed, and the different degree of mobility they have with reſpect to each other: In the ſame manner, if we know the uſe of the nerves in general, we can eaſily aſſign the uſe of thoſe nerves which are diſtributed to any particular part. There is then no occaſion for a complete Oſteology, Myology, &c. of the ſeveral animals we ſhall treat of; nor need we trouble ourſelves about the ſtructure of any of the parts, unleſs when it ſerves to illuſtrate ſome of the fore-mentioned purpoſes *.

That the firſt uſe we propoſed from examining the ſtructure of the parts in brutes is real and of conſequence, is evident from looking into the works of ſome of the earlieſt and greateſt maſters of anatomy, who, for want of human ſubjects, have often borrowed their deſcriptions from other animals. The great Veſalius, although he juſtly reproves Galen for this fault, is guilty of the ſame himſelf, as is plain from his delineations of the kidneys, uterus, the muſcles of the eye, and ſome other

* Notwithſtanding this aſſertion of the learned author, we muſt obſerve, that the myology of animals ſeems exceedingly neceſſary for young anatomiſts, who generally begin with diſſecting them before they have acceſs to human bodies. For this reaſon, we have added, not indeed a complete myology, but an account of the particulars wherein the muſcles of a dog differ from thoſe of a man; this being the animal moſt frequently choſen for diſſections, and one of thoſe whoſe ſtructure bears no ſmall reſemblance to that of the human ſpecies.

other parts. Nor is antiquity only to be charged with this; ſince, in Willis's *Anatomia Cerebri* (the plates of which were reviſed by that accurate anatomiſt Dr Lower), there are ſeveral of the pictures taken from different brutes, eſpecially the dog, beſides thoſe he owns to be ſuch.

We ſhall give ſeveral examples of the ſecond uſe in the ſequel of the work.

The animal kingdom, as well as the vegetable, contains the moſt ſurpriſing variety; and the deſcent in each is ſo gradual, that the little tranſitions and deviations are almoſt imperceptible. The bat and flying-ſquirrel, though quadrupeds, have wings to buoy themſelves up in the air. Some birds inhabit the waters; and there are fiſhes that have wings, and are not ſtrangers to the airy regions; the amphibious animals blend the terreſtrial and aquatic together.

The animal and vegetable kingdoms are likewiſe ſo nearly connected, that if you take the higheſt of the one, and the loweſt of the other, there will ſcarce be preſerved any difference. For inſtance, what difference is there betwixt an oyſter, one of the moſt inorganiſed of the animal tribe, and the ſenſitive plant, the moſt exalted of the vegetable kingdom? They both remain fixed to one ſpot, where they receive their nouriſhment, having no proper motion of their own, ſave the ſhrinking from the approach of external injuries. Thus we obſerve a ſurpriſing chain in nature.

As there is then ſuch a vaſt variety, it is not only needleſs, but impoſſible, to conſider all of them particularly. We ſhall take only ſome of the moſt remarkable genera; and hope, from what will be ſaid of them, any of the intermediate degrees may be underſtood.

In treating of QUADRUPEDS, we ſhall divide them into the carnivorous and herbivorous. As an inſtance of theſe laſt, we ſhall take the rumi-

nant kind. The FOWLS we ſhall divide into thoſe that feed on grain, and thoſe that feed on fleſh. The diſtinction we ſhall make in treating of FISHES, ſhall be of thoſe that have lungs, and thoſe that have them not. The firſt indeed are with difficulty procured, and at the ſame time differ very little from quadrupeds.

As the ſtructure of inſects and worms is ſo very minute, and lends us but little aſſiſtance for the ends propoſed, we purpoſely omit them *.

In inquiring into the ſtructure of different animals, we ought to be previouſly acquainted with the form of their body, manner of life, kind of food, or in ſhort with their natural hiſtory; which will lead us to account for the reaſon of their different ſtructure, and thence explain the actions of the human body.

* Though the anatomy of inſects is very difficult and little known, yet as they conſtitute one of the great claſſes into which animals are divided, and as many of them are very uſeful to man, we have thought proper to add a few circumſtances concerning them, which at leaſt may be conſidered as matters of curioſity highly worthy of the attention of every anatomiſt; not to mention, that every advance in knowledge, with reſpect to the ſtructure of any one animal, muſt either directly or indirectly caſt ſome light on the ſtructure of ſome part of every other.

Of QUADRUPEDS in general.

ALL quadrupeds have a covering of hair, wool, &c. to defend them from the injuries of the weather; which varies in thickneſs according to the ſeaſon of the year, and difference of the climate. Thus in Ruſſia and the northern countries, the furs are very thick and warm; while the little Spaniſh lap-dogs, and Barbary cows, have little or no hair at all.

The *cutis* and *cuticula* in quadrupeds are diſpoſed much in the ſame way as the human, only more elaſtic. Immediately under this there is a very thin cutaneous muſcular ſubſtance, called *panniculus carnoſus*, which is common to all quadrupeds, the porcine kind excepted; this principally covers the trunk, ſerving to ſhrivel the ſkin, in order to drive off inſects, their tails and heads not being ſufficient for this purpoſe, while their extremities are employed in their ſupport and progreſſion.

It has probably been from obſerving ſome muſcles of the human body, ſuch as the platyſma myoides, cremaſter, and frontales, and the collapſed tunica celluloſa of emaciated ſubjects, to reſemble this thin muſcle, that ſome of the older anatomiſts reckoned ſuch a panniculus among the common teguments of the human body. This Carolus Stephanus has well obſerved.

Moſt part of quadrupeds want clavicles, whereby their anterior extremities fall upon their cheſt, ſo as to make their thorax proportionally narrower than the human. This ſmall diſtance of their anterior extremities is very neceſſary for their uniform progreſſion: Apes indeed, and ſquirrels, have clavicles, to allow them a more full uſe of their extremities in climbing; but when they ſit down on all-fours, they walk but indifferently.

The ANATOMY of a DOG.

WE may firſt obſerve of this animal, as indeed of moſt quadrupeds, that its legs are much ſhorter in proportion to its trunk, than in man, the length of whoſe ſteps depends entirely on the length of his inferior extremities; however, to balance this, the trunk of the animal is proportionally longer and ſmaller, and his ſpine more flexible, by which he is able at each ſtep to bring his poſterior extremities nearer to his anterior. His common teguments are much a-kin to thoſe of other quadrupeds: only they allow little or no paſſage for ſweat; but, when he is overheated, the noxious and ſuperfluous matter finds an exit by the ſalivary glands; for he rolls out his tongue, and ſlavers plentifully *.

The pyramidal muſcles are wanting; to ſupply which, the rectus is inſerted fleſhy into the os pubis.

The *omentum* reaches down to the os pubis; which, conſidering the poſture of the animal, we will find to be a wiſe proviſion, ſince its uſe is to ſeparate an oily liquor for lubricating the guts, and facilitating their periſtaltic motion. So, in our erect poſture, the natural gravity of the oil will determine it downward; but in the horizontal poſition of theſe creatures, if all the inteſtines were not covered, there would be no favourable derivation of the fluid to the guts lying in the poſterior part

* We are not, however, to ſuppoſe, that becauſe a dog does not ſweat, he has no inſenſible perſpiration. That a dog perſpires is evident, becauſe one of theſe animals can trace another by the ſcent of his footſteps; which could not happen, if a large quantity of perſpirable matter was not conſtantly going off. We may alſo obſerve, that the diſeaſe called *Rabies Canina*, is peculiar to dogs, foxes, wolves, and others of that genus; for though the bite of other mad animals, ſuch as cats, or hogs, and even poultry, will produce the diſeaſe, no fair inſtance has ever been brought of any of theſe being originally ſeized with this malady.

part of the abdomen, which is the higheſt: and beſides, had the omentum reached much farther down in us, it would not only have ſupplied too great a quantity of oil to the lower part of the abdomen, but we would have been in continual danger of herniæ; and even at preſent, the omentum frequently paſſes down with ſome of the other viſcera, and forms part of theſe tumours. To theſe, however, the dog is not ſubject, as his viſcera do not preſs ſo much on the rings of the abdominal muſcles, and beſides are prevented from paſſing through by a pendulous flap of fat, mentioned p. 30. The inferior and anterior lamella of the omentum is fixed to the ſpleen, fundus of the ſtomach, pylorus, liver, &c. in the ſame way as the human; but the ſuperior having no colon to paſs over, goes directly to the back-bone. This ſerves to explain the formation of the ſmall omentum in the human body; which is nothing but the large omentum, having loſt its fat, paſſing over the ſtomach and colon, where it reaſſumes its pinguedo, ſo proceeds, and is firmly attached to the liver, ſpine, &c. The ſtriæ of fat are pretty regularly diſpoſed through it, accompanying the diſtribution of the blood-veſſels to guard them from the preſſure of the ſuperincumbent viſcera.

This animal's ſtomach, though pretty much reſembling the human in its ſhape, is ſomewhat differently-ſituated. It lies more longitudinal, as indeed all the other viſcera do to accommodate themſelves to the ſhape of the cavity in which they are contained; that is, its inferior orifice is much farther down with reſpect to the ſuperior than the human: by this means the groſs food has an eaſier paſſage into the duodenum. Again, the fundus of the human ſtomach, when diſtended, ſtands almoſt directly forwards, which is occaſioned by the little omentum tying it ſo cloſe down to the back-bone, &c. at its two orifices; but it not being

ing fixed in that manner in the dog, the fundus remains always posterior: this also answers very well the shape of the different cavities, the distance betwixt the cardia and fundus being greater than that betwixt the two sides. It seems to be much larger in proportion to the bulk of the animal than the human, that it might contain a greater quantity of food at once; which was very necessary, since this animal cannot at any time get its sustenance as men do. The turbillion is not so large, nor is there any coarction forming the *antrum Willisii* as in the stomach of man. It is considerably thicker and more muscular than ours, for breaking the cohesion of their food, which they swallow without sufficient chewing. Hence it is evident the force of the stomach is not so great as some would have it, nor its contraction so violent: otherwise that of dogs would be undoubtedly wounded by the sharp bones, &c. they always take down; for the contraction here is still greater than in the human stomach, which is much thinner. The rugæ of the tunica villosa are neither so large, nor situated transversely, as in the human; but go from one orifice to the other: the reason of which difference is, perhaps, that they might be in less danger of being hurt by the hard substances this creature frequently feeds upon; and for the same reason there is not the like coarction at their pylorus.

The intestines of this animal are proportionally much shorter than ours: for the food which these creatures mostly use, soon dissolves, and then putrifies; on which account there was no occasion for a long tract of intestines, but on the contrary that it should be quickly thrown out of the body. The same is to be observed of all the carnivorous animals. The muscular coat of the intestines is also thicker and stronger than the human, to protrude the contents quickly and accurately.

The

The valvulæ conniventes are leſs numerous, and in a longitudinal direction; and the whole tract of the alimentary canal is covered with a ſlime, which lubricates the inteſtines, ſaves them from the acrimony of the excrementitious part, and facilitates its paſſage.

The *duodenum* differs conſiderably in its ſituation from the human. For in man it firſt mounts from the pylorus upwards, backwards, and to the right-ſide; then paſſes down by the gall-bladder; and, marching over the right kidney and ſuperior part of the pſoas muſcles, makes a curvature upwards; and paſſes over the back-bone and vena cava inferior, to the left hypochondrium, where it gets through the omentum, meſentery, and meſocolon, to commence *jejunum*, being firmly tied down all the way, the biliary and pancreatic ducts entering at its moſt depending part: Whereas, in the dog, the duodenum is fixed at the pylorus to the concave ſurface of the liver, and hangs looſe and pendulous with the meſentery backwards into the cavity of the abdomen; then turning up again, is fixed to the back-bone, where it ends in the jejunum; the bile and pancreatic juice are poured into it at the moſt depending part. Therefore the ſame intention ſeems to have been had in view in the formation of this part in both, viz. the giving the chyle, after the liquors of the liver and pancreas are poured into it, a diſadvantageous courſe, that ſo it might be the more intimately blended with the humours before its entry into the jejunum, where the lacteals are very numerous: And thus, by reaſon of their different poſture, the ſame deſign (though by a very different order of the parts) is brought about in both.

The other ſmall guts are much the ſame with ours, only ſhorter. The great guts are alſo ſhorter and leſs capacious than in the human body; and we take it for a general rule, that all animals that live

live on vegetable food, have not only their ſmall guts conſiderably longer, but alſo their great guts more capacious, than ſuch creatures as feed on other animals. Hence man, from this form of his inteſtines, and that of the teeth, ſeems to have been originally deſigned for feeding on vegetables chiefly; and ſtill the moſt of his food, and all his drink, is of that claſs.

The reaſon of this difference ſeems to be, that as animal-food is not only much more eaſily reduced into chyle, but alſo more prone to putrefaction, too long a remora of the juices might occaſion the worſt conſequences. So it was neceſſary that their receptacles ſhould not be too capacious; but on the contrary, being ſhort and narrow, might conduce to the ſeaſonable diſcharge of their contents. Whereas vegetable food being more difficultly diſſolved and converted into an animal nature, there was a neceſſity for ſuch creatures as fed on it to be provided with a long internal canal, that this food in its paſſage might be conſiderably retarded, and have time to change its indoles into one more agreeable to our nature. Beſides which, there is another advantage which accrues to man in particular, from having his great guts very capacious: for as he is a rational being, and moſtly employed in the functions of ſocial life, it would have been very inconvenient as well as unbecoming for him to be too frequently employed in ſuch ignoble exerciſes; ſo that, having this large reſervoir for his fæces alvinæ, he can retain them for a conſiderable time without any trouble.

The *appendix vermiformis* juſtly enough deſerves the name of an *inteſtinum cæcum* in this ſubject, though in the human body it does not; and it has probably been from the largeneſs of this part in other animals, that the oldeſt anatomiſts came to reckon that ſmall appendicle in man as one of the great

great guts. On its internal ſurface we obſerve a great number of mucous glands *.

The *colon* has no longitudinal ligaments; and conſequently this gut is not purſed up into different bags or cells, as the human: nor does this inteſtine make any circular turn round the abdomen; but paſſes directly acroſs it to the top of the os ſacrum, where it gets the name of *rectum*.

At the extremity of the *inteſtinum rectum*, or verge of the anus, there are found two bags or paunches, which contain a moſt abominable fetid mucus, for which I know no uſe, unleſs it ſerves to lubricate the ſtrained extremity of the rectum, and defend it againſt the aſperity of the faeces, or to ſeparate ſome liquor that might otherwiſe prove hurtful to their bodies. There is nothing analagous to thoſe facs in the human ſubject, unleſs we reckon the mucilaginous glands that are found moſt frequent and largeſt about the lower part of the rectum.

The *meſentery* is conſiderably longer than in the human body; that, in his horizontal ſituation, the inteſtines may reſt ſecurely on the ſoft cuſhion of the abdominal muſcles. The fat is here diſpoſed in the ſame way, and for the ſame reaſon, as in the omentum. The interſtices betwixt the fat are filled with a fine membrane. Inſtead of a great number of glandulæ vagæ to be found in the human meſentery, we find the glands few in number, and thoſe are cloſely connected together; or there

* As all theſe throw out ſlime, their principal office would ſeem to be the procuring a ſufficient quantity of that matter for the purpoſes above-mentioned. Still, however, there ſeems to be ſome unknown uſe for this organ in other animals; for the appendicula vermiformis in them is either of great ſize or of great length. In a rat, it is rather larger than the ſtomach; in others, as ſwine, and ſome of the animals which live on vegetables, it has long convolutions, ſo that the food muſt be lodged in it for a long time. Thus, probably, ſome change takes place in the food, which requires a conſiderable time to effectuate, and, though unknown to us, may anſwer very uſeful purpoſes to the animal.

there is only one large gland to be obſerved in the middle of the meſentery of a dog, which, from its imagined reſemblance to the pancreas and the name of its diſcoverer, is called *pancreas Aſellii*; but the reſemblance, if there is any, depends chiefly on the connection, the ſtructure being entirely different. The reaſon why this in man is as it were ſubdivided into many ſmaller ones, may poſſibly be, that as the guts of a human body are proportionally much longer than thoſe of this creature, it would have been inconvenient to have gathered all the *lactea primi generis* into one place; whereas, by collecting a few of theſe veſſels into a neighbouring gland, the ſame effect is procured much more eaſily. Whether the food in this animal needs leſs preparation in its paſſage through theſe glands, is a matter very much unknown to us; though it is certain that ſome changes really do take place.

The *pancreas* in man lies acroſs the abdomen, tied down by the peritoneum; but the capacity of this creature's abdomen not allowing of that ſituation, it is diſpoſed more longitudinally, being tied to the duodenum, which it accompanies for ſome way. Its duct enters the duodenum about half an inch below the others.

The *ſpleen* of this animal differs from ours very much, both in figure and ſituation. It is much more oblong and thin, and lies more according to the length of the abdomen, like the pancreas. Though the ſpleen of this creature is not firmly tied to the diaphragm (which was neceſſary in our erect poſture to hinder it from falling downwards), yet by the animal's prone poſition, its poſterior parts being rather higher than the anterior, it comes to be always contiguous to this muſcle, and is as effectually ſubjected to an alternate preſſure from its action as the human ſpleen is.

The human *liver* has no fiſſures or diviſions, unleſs

leſs you pleaſe to reckon that ſmall one betwixt the two *pylæ*, where the large veſſels enter: Whereas in a dog, and all other creatures that have a large flexion in their ſpine, as lions, leopards, cats, &c. the liver and lungs are divided into a great many lobes by deep ſections, reaching the large blood-veſſels, which in great motions of the back-bone may eaſily ſhuffle over one another; and ſo are in much leſs danger of being torn or bruiſed, than if they were formed of one entire piece, as we really ſee it is in horſes, cows, and ſuch creatures as have their back-bone ſtiff and immoveable. There is here no *ligamentum latum* connecting the liver to the diaphragm, which in our ſituation was neceſſary to keep the viſcus in its place: Whereas in this creature, it naturally gravitates forwards, and by the horizontal poſition of the animal is in no danger of preſſing againſt the vena cava; the preventing of which is one uſe generally aſſigned to this ligament in man. Had the liver of the dog been thus connected to the diaphragm, the reſpiration muſt neceſſarily have ſuffered; for, as we ſhall ſee afterwards, this muſcle is here moveable at the centre, as well as at the ſides: But in man the liver is fixed to the diaphragm, moſtly at its tendinous part; that is, where the pericardium is fixed to it on the other ſide; ſo that it is in no danger of impeding the reſpiration, being ſuſpended by the mediaſtinum and bones of the thorax. In conſequence of this viſcus being divided into ſo many lobes, it follows, that the hepatic ducts cannot poſſibly join into one common trunk till they are quite out of the ſubſtance of the liver; becauſe a branch comes out from every lobe of the liver; all of which, by their union, form the hepatic duct: whence we are led to conclude, that the hepato-cyſtic ducts, mentioned by former authors, do not exiſt. The gall-bladder itſelf is wanting in ſeveral animals, ſuch as the deer, the

horſe, the aſs, &c.; but in place of it, in ſuch animals, the hepatic duct, at its beginning, is widened into a reſervoir of conſiderable ſize, which may anſwer the ſame purpoſe in them that the gall-bladder does in others.

We come next, after having examined the chylopoietic viſcera, to diſcourſe of thoſe organs that ſerve for the ſecretion and excretion of urine. And firſt of the kidneys: Which in this animal are ſituated much in the ſame way as in the human ſubject; but have no fat on their inferior ſurface, where they face the abdomen, and are of a more globular form than the human. The reaſon of theſe differences will eaſily appear, if you compare their ſituation and poſture in this animal with thoſe in a man who walks erect. They are placed in this ſubject in the inferior part of the body, ſo are not ſubject to the preſſure of the viſcera, which ſeems to be the principal cauſe of the fatneſs of thoſe organs in us, and perhaps may likewiſe be the cauſe of our being more ſubject to the ſtone than other animals. Hence there is no need of any cellular ſubſtance to ward off this preſſure where there would neceſſarily be fat collected; but the ſuperior part of their kidneys is pretty well covered with fat, leſt they ſhould ſuffer any compreſſion from the action of the ribs and ſpine.

In the internal ſtructure there is ſtill a more conſiderable difference: For the *papillæ* do not here ſend out ſingle the ſeveral *tubuli uriniferi*; but being all united, they hang down in form of a looſe pendulous flap in the middle of the pelvis, and form a kind of ſeptum medium; ſo that a dog has a pelvis formed within the ſubſtance of the kidney. The only thing that is properly analogous to a pelvis in man is that ſac or dilatation of the ureters formed at the union of the *ductus uriniferi*. The external part of the kidney of a dog ſomewhat reſembles

ſembles one of the lobes of the kidney of a human fœtus: but in a human adult the appearance is very different; becauſe, in man, from the continual preſſure of the ſurrounding viſcera, the lobes, which in the fœtus are quite diſtinct and ſeparated, concrete, but the original cortical ſubſtance is ſtill preſerved in the internal parts of the kidney. The reaſon of theſe particularities may probably be, that the liquors of this animal, as of all thoſe of the carnivorous kind, being much more acrid than thoſe that live on vegetable food, its urine muſt incline much to an alkaleſcency, as indeed the ſmell and taſte of that liquor in dogs, cats, leopards, &c. evidently ſhow, being fetid and pungent, and therefore not convenient to be long retained in the body. For this end it was proper, that the ſecerning organs ſhould have as little impediment as poſſible by preſſure, &c. in the performing their functions; and for that deſign, the mechaniſm of their kidneys ſeems to be excellently adapted: We have moſt elegant pictures in Euſtachius of the kidneys of brutes, delineated as ſuch, with a view to ſhow Veſalius's error in painting and deſcribing them for the human.

The *glandulæ* or *capſulæ atrabiliariæ* are thicker and rounder than the human, for the ſame reaſon as the kidneys.

The *ureters* are more muſcular than the human, becauſe of the unfavourable paſſage the urine has through them; they enter the bladder near its fundus.

The bladder of urine differs conſiderably from the human; and firſt in its form, which is pretty much pyramidal or pyriform. This ſhape of the dog's bladder is likewiſe common to all quadrupeds, except the ape and thoſe of an erect poſture. In men it is by no means pyriform, but has a large ſac at its poſterior and inferior part:

this form depends entirely on the urine gravitating in our erect posture to its bottom, which it will endeavour to protrude; but as it cannot yield before, being contiguous to the os pubis, it will naturally stretch out where there is the least resistance, that is, at the posterior and lateral parts; and were it not for this sac, we could not so readily come at the bladder to extract the stone either by the lesser or lateral operation of lithotomy. Most anatomists have delineated this wrong; so much, that I know of none who have justly painted it, excepting Mr Cowper in his *Myotomia*, and Mr Rutty. It has certainly been from observing it in brutes and young children, that they have been led into this mistake. The same cause, *viz.* the gravity of the urine, makes the bladder of a different form in brutes: In their horizontal position the cervix, from which the urethra is continued, is higher than its fundus; the urine must therefore distend and dilate the most depending part by its weight.

As to its *connection*, it is fastened to the abdominal muscles by a process of the peritoneum, and that membrane is extended quite over it; whereas in us its superior and posterior parts are only covered by it: hence in man alone the high operation of lithotomy can be performed without hazard of opening the cavity of the abdomen. Had the peritoneum been spread over the bladder in its whole extent, the weight of the viscera in our erect posture would have so bore upon it, that they would not have allowed any considerable quantity of urine to be collected there; but we must have been obliged to discharge its contents too frequently to be consistent with the functions of a social life: Whereas by means of the peritoneum, the urine is now collected in sufficient quantity, the viscera not gravitating this way.

You may take it for a general rule, that those creatures

creatures that feed upon animal-food have their bladder more muſcular and conſiderably ſtronger, and leſs capacious, than thoſe that live on vegetables, ſuch as horſes, cows, ſwine, &c. whoſe bladder of urine is perfectly membranous, and very large. This is wiſely adapted to the nature of their food: For in theſe firſt, as all their juices are more acrid, ſo in a particular manner their urine becomes exalted; which, as its remora might be of very ill conſequence, muſt neceſſarily be quickly expelled. This is chiefly effected by its ſtimulating this viſcus more ſtrongly to contract, and ſo to diſcharge its contents, though the irritation does not altogether depend upon the ſtretching, but likewiſe ariſes from the quality of the liquor. That a ſtimulus is one of the principal cauſes of the excretion of urine, we learn from the common ſaline diuretic medicines that are given, which are diſſolved into the ſerum of the blood, and carried down by the kidneys to the bladder: The ſame appears likewiſe from the application of cantharides; or without any of theſe, when the parts are made more ſenſible, as in an excoriation of the bladder, there is a frequent deſire to make water. Accordingly we find theſe animals evacuate their urine much more frequently than man, or any other creature that lives on vegetable food. And if theſe creatures, whoſe fluids have already a tendency to putrefaction, are expoſed to heat or hunger, the liquids muſt for a conſiderable time undergo the actions of the containing veſſels, and frequently perform the courſe of the circulation, without any new ſupplies of food; by which the fluids becoming more and more acrid, the creature is apt to fall into ſeveriſh and putrid diſeaſes: And in fact, we find that fatal and melancholy diſtemper the *rabies canina, vulpina*, &c. frequent in theſe animals; whereas

thoſe that feed on vegetable food ſeldom or never contract theſe diſeaſes but by infection.

Their *ſpermatic veſſels* are within the peritoneum, which is ſpread over them, and from which they have a membrane like a meſentery, ſo hang looſe and pendulous in the abdomen: whereas, in us, they are contained in the cellular part of the peritoneum, which is tenſely ſtretched over them. At their paſſage out of the lower belly, there appears a plain perforation, or holes; hence the adult quadruped, in this reſpect, reſembles the human fœtus. And from obſerving this in quadrupeds, has ariſen the falſe notion of *hernia* or *rupture* among authors. This opening, which leads down to the teſticle, is of no diſadvantage to them, but evidently would have been to us; for from the weight of our viſcera, and our continually gravitating upon theſe holes, we muſt have perpetually laboured under enteroceles. This they are in no hazard of, ſince in them this paſſage is at the higheſt part of their belly, and, in their horizontal poſture, the viſcera cannot bear upon it: And, to prevent even the ſmalleſt hazard, there is a looſe pendulous ſemilunar flap of fat; which ſerves two uſes, as it both hinders the inteſtines from getting into the paſſage, and alſo the courſe of the fluids from being ſtopped in the veſſels, which is ſecured in us by the cellular ſubſtance and tenſe peritoneum: And it may be worth while to obſerve, that this proceſs remains almoſt unaltered, even after the animal has been almoſt exhauſted of fat.

There is next a paſſage quite down into the cavity, where the teſticles lie. Had the ſame ſtructure obtained in man, by the conſtant drilling down of the liquor which is ſecerned for the lubricating of the guts, we ſhould always have laboured under an hydrocele; but their poſture ſecures them from any hazard of this kind: indeed

your

your very fat lap-dogs, who conſequently have an overgrown omentum, are ſometimes troubled with an epiplocele.

The *ſcrotum* is ſhorter and not ſo pendulous as the human in all the dog kind that want the *veſiculæ ſeminales*; that the ſeed at each copulation might the ſooner be brought from the teſtes, thus in ſome meaſure ſupplying the place of the *veſiculæ ſeminales*; for the courſe of the ſeed through the *vaſa deferentia* is thus ſhortened, by placing the ſecerning veſſels nearer the excretory organs *. The want of *veſiculæ ſeminales* at the ſame time explains the reaſon why this creature is ſo tedious in copulation. But why theſe bodies are abſent in the dog-kind more than in other animals, is a circumſtance we know nothing of.

The ſtructure of the *teſticles* is much the ſame with the human; as are likewiſe the *corpus pyramidale*, *varicoſum*, or *pampiniforme*, and the *epididymis* or excretory veſſel of the teſticle. The *vaſa deferentia* enter the abdomen where the blood-veſſels come out; and, paſſing along the upper part of the bladder, are inſerted a little below the bulbous part of the urethra.

The præputium has two muſcles fixed to it: one that ariſes from the ſphincter ani, and is inſerted all along the *penis*; and this is called *retractor præputii*: But the other, whoſe office is directly contrary to this, is cutaneous; and ſeems to take its origin from the muſcles of the abdomen, or rather to be a production of their tunica carnoſa. The *corpora cavernoſa* riſe much in the ſame way as the human: but theſe ſoon terminate; and the reſt is ſupplied by a triangular bone, in the inferior part of which there is a groove excavated for lodging the urethra. There are upon the penis two

* Perhaps its paſſage is likewiſe quickened by the muſcular power of the vaſa deferentia, which is ſtronger in this creature than in man.

two protuberant bulbous fleshy substances, resembling the glans penis in man, at the back of which are two veins, which by the *erectores penis* and other parts are compressed in the time of coition; and the circulation being stopped, the blood distends the large cavernous bodies. After the penis is thus swelled, the vagina, by its contraction and swelling of its corpus cavernosum, which is considerably greater than in other animals, gripes it closely; and so the male is kept in action some time contrary to his will, till time be given for bringing a quantity of seed sufficient to impregnate the female: and thus, by that *orgasmus veneris* of the female organs, the want of the *vesiculæ seminales* are in some measure supplied. But as it would be a very uneasy posture for the dog to support himself solely upon his hinder feet, and for the bitch to support the weight of the dog for so long a time; therefore, as soon as the bulbous bodies are sufficiently filled, he gets off and turns averse to her: had, then, the penis been pliable as in other animals, the urethra must of necessity have been compressed by this twisting, and consequently the course of the seed intercepted; but this is wisely provided against by the urethra's being formed in the hollow of the bone. After the emission of the seed, the parts turn flaccid, the circulation is restored, and the bulbous parts can be easily extended.

The *prostata* seems here divided into two, which are proportionably larger than the human, and afford a greater quantity of that liquid.

The *uterus* of multiparous animals is little else but a continuation of their vagina, only separated from it by a small ring or valve. From the *uterus* two long canals mount upon the loins, in which the fœtuses are lodged: these are divided into different sacs, which are strongly constricted betwixt each fœtus; yet these coarctions give way in the time

time of birth. From these go out the *tubæ Fallopianæ*, so that the ovaria come to lodge pretty near the kidneys.

We ought next to examine the structure of the thorax and its contents. But first it may not be amiss to remark of the *diaphragm* in its natural situation, that it is in general more loose and free than the human; which is owing to its connection with the neighbouring parts in a different manner from ours. The human *diaphragm* is connected to the pericardium; which again, by the intervention of the mediastinum, is tied to the sternum, spine, &c. but here there is some distance between the diaphragm and pericardium. We observe further, that its middle part is much more moveable, and the tendinous parts not so large. And indeed it was necessary their *diaphragm* should be somewhat loose, they making more use of it in difficult respiration than man. This we may observe by the strong heaving of the flanks of an horse or dog when out of breath; which corresponds to the rising of the ribs in us.

The disposition and situation of the *mammæ* vary as they bear one or more young. Those of the uniparous kind have them placed between the posterior extremities, which in them is the highest part of their bodies, whereby their young get at them without the inconvenience of kneeling: Nevertheless, when the creatures are of no great size, and their breast large, as in sheep, the young ones are obliged to take this posture. In multiparous animals, they must have a great number of nipples, that their several young ones may have room at the same time, and these disposed over both thorax and abdomen; and the creatures generally lie down when the young are to be suckled, that they may give them the most favourable situation. From this it does not appear to be from any particular fitness of the vessels at certain pla-

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ces for giving a proper nouriſhment to the child, that the breaſts are ſo placed in women as we find them, but really from that ſituation being the moſt convenient both for mother and infant.

The *ſternum* is very narrow, and conſiſts of a great number of ſmall bones, moveable every way; which always happens in creatures that have a great mobility in their ſpine. The ribs are ſtraighter, and by no means ſo convex as the human; whereby in reſpiration the motion forward will very little enlarge their thorax, which is compenſated by the greater mobility of their diaphragm: ſo our thorax is principally enlarged according to its breadth and depth, and theirs according to its length. The want of clavicles, and the conſequent falling in of the anterior extremities upon the cheſt, may contribute ſomewhat to the ſtraitneſs of the ribs.

The *mediaſtinum* in this creature is pretty broad. The pericardium is not here contiguous to the diaphragm, but there is an inch of diſtance betwixt them, in which place the ſmall lobe of the lungs lodges; and by this means the liver, &c. of this animal, though continually preſſing upon the diaphragm, yet cannot diſturb the heart's motion.

The heart is ſituated with its point almoſt directly downwards, according to the creature's poſture, and is but very little inclined to the left ſide. Its point is much ſharper, and its ſhape more conoidal, than the human. Here the names of *right* and *left* ventricles are proper enough, though not ſo in the human; which ought rather to be called *anterior* and *poſterior*, or *ſuperior* and *inferior*. The animal has the *vena cava* of a conſiderable length within the thorax, having near the whole length of the heart to run over ere it gets at the *ſinus Lowerianus dexter*. In men, as ſoon as it pierces the diaphragm, ſo ſoon it enters the

the pericardium, which is firmly attached to it, and immediately gets into the *ſinus Lowerianus*; which ſinus, in the human ſubject, by the oblique ſituation of the heart is almoſt contiguous to the diaphragm: and by this we diſcover, that ſeveral authors have taken their delineations of the human heart from brutes; which is eaſily detected by the ſhape and ſituation of the heart, and long vena cava, within the thorax. This was one of the faults of the curious wax-work that were ſhown at London and Paris, which were plainly taken from a cow.

This ſituation of the heart of the creature agrees beſt with the ſhape of its thorax, which is lower than the abdomen.

The egreſs of the large blood-veſſels from the heart is ſomewhat different from the human: For here the right ſubclavian comes off firſt; and as a large trunk runs ſome way upwards before it gives off the left carotid, and ſplits into the carotid and ſubclavian of the right ſide, then the left ſubclavian is ſent off. So that neither here, properly ſpeaking, is there an *aorta aſcendens* more than in the human; but this name has probably been impoſed upon it from obſerving this in a cow, where indeed there is an aſcending and deſcending aorta.

From this ſpeciality of the diſtribution of the veſſels of the right ſide, which happens, though not in ſo great a degree, in the human ſubject, we may perhaps in ſome meaſure account for the general greater ſtrength, readineſs, or faculty of motion, which is obſervable in the right arm. I believe, upon meaſuring the ſides of the veſſels, the ſurface of the united trunk of the right ſubclavian and carotid is leſs than that of the left ſubclavian and carotid, as they are ſeparated. If ſo, the reſiſtance to the blood muſt be leſs in that common trunk than in the left ſubclavian and carotid:

rotid: But if the reſiſtance be ſmaller, the abſolute force with which the blood is ſent from the heart being equal, there muſt neceſſarily be a greater quantity of blood ſent through them in a given time; and as the ſtrength of the muſcles is, *ceteris paribus*, as the quantity of blood ſent into into them in a given time, thoſe of the right arm will be ſtronger than thoſe of the left. Now children, being conſcious of this ſuperior ſtrength, uſe the right upon all occaſions; and thus from uſe comes that great difference which is ſo obſervable. That this is a ſufficient cauſe, ſeems evident from fact; for what a difference is there betwixt the right and the left arm of one who has played much at tennis? View but the arms of a blackſmith and legs of a footman, and you will ſoon be convinced of this effect ariſing from uſing them. But if by any accident the right arm is kept from action for ſome time, the other from being uſed gets the better; and thoſe people are left-handed: For it is not to be imagined, that the ſmall odds in the original formation of the veſſels ſhould be ſufficient to reſiſt the effect of uſe and habit, (inſtances of the contrary occur every day); it is enough for our preſent argument, that where no means are uſed to oppoſe it, the odds are ſufficient to determine the choice in favour of the right. Now becauſe it is natural to begin with the leg correſponding to the hand we have moſt power of, this is what gives alſo a ſuperiority to the right leg.

This difference is not peculiar to man, but is ſtill more obſervable in thoſe creatures in whom the ſame mechaniſm does obtain in a greater degree. Do but obſerve a dog at a trot, how he bears forwards with his right ſide; or look at him when a-ſcraping up any thing, and you will preſently ſee that he uſes his right much oftener than

he does his left foot. Something analogous to this may be obſerved in horſes *.

The *thymus* of this creature is proportionably much larger than ours: whereas the glandula thryoidea is much leſs, and is divided into two diſtinct parts, or there are two ſeparate glands; which is not the caſe in man. The reaſon of this difference is unknown, as is likewiſe the uſe of the gland itſelf. It is generally remarked, that theſe two glands do thus always ſupply the place of each other; that is, in ſuch animals as have a large thymus, the glandula thryoidea is ſmaller, and *vice verſa*. Hence we are naturally led to aſcribe the ſame uſe to both, viz. the ſeparation of a thin lymph for diluting the chyle in the thoracic duct before it be poured into the blood; then if we conſider the different formation of the thorax in both, we ſhall readily account for the variety in the bulk of theſe two glands. Reſpiration being chiefly performed in man by the widening of the cheſt, the lungs at every inſpiration muſt preſs upon the thymus, and conſequently diminiſh it: but the diaphragm yielding more in the dog's inſpiration, this gland is not ſo much preſſed by the lungs, and ſo will be larger; and hence the glandula thyroidea will be proportionably leſs. Again, from the poſture of this creature, we ſhall ſee that it was much more convenient for a dog to have the moſt part of the diluting lymph ſupplied by the thymus, ſince the neck being frequently in a deſcending poſture, the lymph of the thyroid gland would have a very diſadvantageous courſe to get to the thoracic duct: whereas in the

* It has been the opinion of ſome anatomiſts, that left-handed people, as well as thoſe diſtinguiſhed by the name of *ambidexter* (who uſe both hands promiſcouſly), have the two carotid and ſubclavian arteries coming off in four diſtinct trunks from the arch of the aorta: but no appearance of this kind has ever been obſerved in ſuch bodies as have been examined for this purpoſe; though indeed theſe have been but few, and more experience might throw greater light on the ſubject.

human body, the thymus is really below the lacteal canal, where it makes its curvature before it opens into the ſubclavian; and conſequently there is a neceſſity of a conſiderable ſhare of the diluting liquor being furniſhed by the thyroid gland, which is ſituated much higher; ſo that its lymph has the advantage of a perpendicular deſcent.

We may here obſerve, that the *thoracic duct* in a dog has no curvature before it enters the ſubclavian vein, the horiſontal poſition of this animal allowing a favourable enough courſe to the chyle, ſo as not to need that turn to force its paſſage into the blood. It may likewiſe be obſerved, that ſuch animals as walk horiſontally, have the valves of the thoracic duct fewer in number than others. The horſe has only a ſingle pair; while, on the contrary, the ape reſembles man in having ſeveral valves. Thus the lymph is not only forwarded in its paſſage, but the weight of the column is diminiſhed.

The lungs of this creature are divided into more numerous lobes, and deeper, than they are in man, for the ſame reaſon as the liver. The left ſide of the thorax in this animal bears a greater proportion to the right than in man; the one being nearly as three to two, the other as four to three.

In quadrupeds, as well as in man, the lungs are cloſely applied to the containing parts; although this has been denied by ſome.

We look on it as a general rule, that all quadrupeds, as having occaſion to gather their food from the ground, are provided with longer necks than man: but as a long neck not only gives the advantage of too long a lever to the weight of the head, but alſo, when the animal is gathering his food, makes the brain in danger of being oppreſſed with too great a quantity of blood, by the liquor in theſe arteries having the advantage of a

deſcent

deſcent, while that in the veins muſt remount a conſiderable way contrary to its own gravity; it was therefore neceſſary that a part of the length of the neck ſhould be ſupplied by the length of the jaws. Thus we ſee horſes, cows, &c. who have no occaſion for opening their mouths very wide, yet have long jaws. Bull-dogs indeed, and ſuch animals as have occaſion for very ſtrong jaws, muſt of neceſſity have them ſhort; becauſe the longer they are, the reſiſtance to be overcome acts with a longer lever. Another exception to this general rule, is ſuch animals as are furniſhed with ſomething analagous to hands to convey their food to their mouths, as cats, apes, &c. The teeth of this creature plainly ſhew it to be of the carnivorous kind; for there are none of them made for grinding their food, but only for tearing and dividing it. It has ſix remarkable ſharp teeth before, and two very long tuſks behind; both of which the ruminating animals want. Theſe are evidently calculated for laying very firm hold of ſubſtances, and tearing them to pieces; and the vaſt ſtrength of the muſcles inſerted into the lower jaw, aſſiſts greatly in this action; while the molares have ſharp cutting edges, calculated for cutting fleſh, and breaking the hardeſt bones.

Even its poſterior teeth are not formed with rough broad ſurfaces as ours are; but are made conſiderably ſharper, and preſs over one another when the mouth is ſhut, that ſo they may take the firmer hold of whatever comes betwixt them.

The tongue, in conſequence of the length of the jaws, is much longer than ours; and as this creature feeds with his head in a depending poſture, the bolus would always be in danger of falling out of the mouth, were it not for ſeveral prominences or papillæ placed moſtly at the root of the tongue, and crooked backwards in ſuch a manner, as to allow any thing to preſs eaſily down

to the jaws, but to hinder its return. By the papillæ alſo the ſurface of the tongue is increaſed, and a ſtronger impreſſion is made on the ſenſation of taſte. In ſome animals who feed on living creatures, theſe under-hooks are ſtill more conſpicuous; as in ſeveral large fiſhes, where they are almoſt as large as their teeth in the forepart of their mouth, and near as firm and ſtrong.

When we open the mouth, we ſee the *amygdalæ* very prominent in the poſterior part of it; ſo that it would appear at firſt view, that theſe were inconveniently placed, as being continually expoſed to injuries from the hard ſubſtances this creature ſwallows: but upon a more narrow ſcrutiny, we find this provided for by two membranous capſulæ, into which the *amygdalæ*, when preſſed, can eſcape, and remove themſelves from ſuch injuries.

The *velum pendulum palati* is in this creature conſiderably longer than in man, to prevent the food from getting into his noſe; which would happen more frequently in this animal than in man, becauſe of its ſituation while feeding.

In this ſubject, as well as in other quadrupeds, there is no *uvula*; but then the *epiglottis*, when preſſed down, covers the whole rima entirely, and naturally continues ſo: there is therefore a ligament, or rather muſcle, that comes from the os hyoides and root of the tongue, that is inſerted into that part of the epiglottis where it is articulated with the cricoid cartilage, which ſerves to raiſe it from the rima, though not ſo ſtrongly but that it may with a ſmall force be clapped down again.

It may be aſked, however, Why the uvula is wanting here, and not in man? This ſeems to be, that quadrupeds, who ſwallow their food in an horizontal ſituation, have no occaſion for an uvula, though

though it is neceſſary in man on account of his erect ſituation.

In the upper part of the pharynx, behind the cricoid cartilage, there is a pretty large gland to be found, which ſerves not only for the ſeparation of a mucous liquor to lubricate the bolus as it paſſes this way, but alſo ſupplies the place of a valve, to hinder the food from regurgitating into the mouth, which it would be apt to do by reaſon of the deſcending ſituation of the creature's head. In man, the muſcle of the epiglottis is wanting, its place being ſupplied by the elaſticity of the cartilage.

The *œſophagus* is formed pretty much in the ſame way as the human. Authors indeed generally allege, that quadrupeds have their gullet compoſed of a double row of ſpiral fibres decuſſating one another; but this is proper to ruminating animals, who have occaſion for ſuch a decuſſation of fibres. The action of theſe you may eaſily obſerve in a cow chewing her cud.

The *noſe* is generally longer than in man, and its external paſſage much narrower. The internal ſtructure is alſo better adapted for an acute ſmelling, having a larger convoluted ſurface on which the *membrana ſchneideriana* is ſpread; and this is to be obſerved in moſt quadrupeds, who have the oſſa ſpongioſa commonly large, and theſe too divided into a great number of exceſſively fine thin lamellæ. The ſenſibility ſeems to be increaſed in proportion to the ſurface; and this will alſo be found to take place in all the other ſenſes. The elephant, which has a head pretty large in proportion to its body, has the greateſt part of it taken up with the cavity of the noſe and frontal ſinuſes; which laſt extend almoſt over their whole head, and leave but a ſmall cavity for their brains. A very nice ſenſe of ſmelling was not ſo abſolutely neceſſary for man, who has judgment and experience

to direct him in the choice of his food; whereas brutes, who have only their ſenſes, muſt of neceſſity have theſe acute, ſome having one ſenſe in greater perfection than others, according to their different way of life. We not only conclude *à priori* from the large expanded *membrana ſcheideriana*, that their ſenſe of ſmelling is very acute, but we find it ſo by cows and horſes diſtinguiſhing ſo readily betwixt noxious and wholeſome herbs, which they do principally by this ſenſe.

The external *ear* in different quadrupeds is differently framed, but always calculated to the creature's manner of life. In ſhape it commonly reſembles the oblique ſection of a cone from near the apex to the baſis. Hares, and ſuch other animals as are daily expoſed to inſults from beaſts of prey, have large ears directed backwards, their eyes warning them of any danger before; rapacious animals, on the other hand, have their ears placed directly forwards, as we ſee in the lion, cat, &c. The ſlow hounds, and other animals that are deſigned to hear moſt diſtinctly the ſounds coming from below, have their ears hanging downwards; or their ears are flexible, becauſe they move their head for the moſt part with greater difficulty than man. Man again, who muſt equally hear ſounds coming from all quarters, but eſpecially ſuch as are ſent from about his own height, has his external ear placed in a vertical manner, ſomewhat turned forward. In ſhort, wherever we ſee a ſpeciality in the make of this organ in any creature, we ſhall, with very little reflection, diſcover this form to be more convenient for that creature than another. The animal alſo has the power of directing the cone of the ear to the ſonorous body without moving the head. There are ſome differences to be obſerved in the ſtructure of the internal ear in different animals; but we know ſo very little of the uſe of the particular

parts

parts of that organ in the human ſubject, that it is altogether impoſſible to aſſign reaſons for theſe variations in other creatures.

All quadrupeds have at the internal canthus of the EYE a ſtrong firm membrane with a cartilaginous edge, which may be made to cover ſome part of their eye; and this is greater or leſs in different animals as their eyes are more or leſs expoſed to dangers in ſearching after their food. This *membrana nictitans*, as it is called, is not very large in this animal. Cows and horſes have it ſo large as to cover one half of the eye like a curtain, and at the ſame time is tranſparent enough to allow abundance of the rays of light to paſs through it. Fiſhes have a cuticle always over their eyes, as they are ever in danger in that inconſtant element. In this then we may alſo obſerve a ſort of gradation.

All quadrupeds have a ſeventh muſcle belonging to the eye, called *ſuſpenſorius*. It ſurrounds almoſt the whole optic nerve, and is fixed into the ſclerotic coat as the others are. Its uſe is to ſuſtain the weight of the globule of the eye, and prevent the optic nerve from being too much ſtretched, without obliging the four ſtraight muſcles to be in a continual contraction, which would be inconvenient: at the ſame time this muſcle may be brought to aſſiſt any of the other four, by cauſing one particular portion of it to act at a time.

The next thing to be remarked is the figure of the *pupil*, which is different in different animals, but always exactly accommodated to the creature's way of life, as well as to the different ſpecies of objects that are viewed. Man has it circular, for obvious reaſons: an ox has it oval, with the longeſt diameter placed tranſverſely, to take in a larger view of his food: cats, again, have theirs likewiſe oval, but the longeſt diameter placed perpendi-

pendicularly; they can either exclude a bright light altogether, or admit only as much as is neceſſary. The pupil of different animals varies in wideneſs, according as the internal organs of viſion are more or leſs acute: Thus cats and owls, who ſeek their prey in the night, or in dark places, (and conſequently muſt have their eyes ſo formed as that a few rays of light may make a lively impreſſion on the retina), have their pupils in the day-time contracted into a very narrow ſpace, as a great number of rays would oppreſs their nice organs; while in the night, or where the light is faint, they open the pupil, and very fully admit the rays. In the ſame way, when the retina is inflamed, a great number of rays of light would occaſion a painful ſenſation; therefore the pupil is contracted: on the contrary, in dying people, or in a beginning amauroſis, it is greatly dilated, as the eyes on ſuch occaſions are very difficultly affected, and as it were inſenſible.

The poſterior part of the choroid coat, which is called *tapetum*, is of different colours in different creatures. For oxen, feeding moſtly on graſs, have this membrane of a green colour, that it may reflect upon the retina all the rays of light which come from objects of that colour, while other rays are obſcured: Thus the animal ſees its food better than it does other objects. Cats and owls have their tapetum of a whitiſh colour; and for the ſame reaſons have the pupil very dilatable, and their organs of viſion acute: And we ſhall find, that all animals ſee more or leſs diſtinctly in the dark, according as their tapetum approaches nearer to a white or black colour. Thus dogs, who have it of a greyiſh colour, diſtinguiſh objects better in the night than man, whoſe tapetum is dark-brown, and who, I believe, ſees worſt in the dark of any creature; it being originally deſigned that he ſhould reſt from all kinds of em-

ployment

ployment in the night-time. The difference then of the colour of the tapetum, as indeed the fabric of any other part in different creatures, always depends on ſome particular advantage accruing to the animal in its peculiar manner of life from this ſingularity.

We ſhall now proceed to the BRAIN, which we remark in the firſt place is proportionally much ſmaller in all quadrupeds than the human; but, as in man, it is divided into cerebrum and cerebellum, and theſe two parts bear nearly the ſame proportion to one another as in us. There was no ſuch occaſion for ſo great a quantity of brains in thoſe animals as in man; ſeeing in them all its energy is employed in their progreſſion, while man has a great waſte of ſpirits in the exerciſe of his reaſon and intellectual faculties. And beſides all this, a great bulky brain would be inconvenient to theſe creatures, in ſo far as it would add conſiderably to the weight of the head; which having the advantage of a long lever to act with, would require a much greater force to ſupport it than now it does; for the heads of the greateſt part of quadrupeds are not near ſo heavy as they would at ſight ſeem to be, from the *ſinus frontales* being produced a great way upwards to enlarge the organs of ſmelling.

The pits in the anterior part of their ſkulls are much more conſpicuous than in the human cranium; which may be occaſioned by the depending poſture of theſe creatures heads while they gather their food: the brain at this time gravitating much on the bones while they are as yet ſoft, will gradually make impreſſions upon them at theſe places where it riſes into eminences. This is prevented in man moſtly by his erect poſture.

The *falx* is not near ſo large in quadrupeds as in man, as they have little occaſion to be on either ſide, and the two hemiſpheres of the brain

are

are in a great measure hindered from justling against one another in violent motions, by the brain's insinuating itself into the abovementioned pits.

The second process of the *dura mater*, or *tentorium cerebello super-expansum*, is considerably thicker and stronger in most quadrupeds than in man; especially in such of them as are very swift of foot, as hares and rabbits, and that most when they are old. This membrane is generally ossified, or we find the place of it supplied by a bone, that it may the more effectually keep off the weight of the superincumbent brain from the cerebellum in their rapid motions, which otherwise would be of bad consequence.

The olfactory nerves are very large, and justly deserve the name of *processus mamillaris*. They are hollow, and consist of a medullary and cineritious substance, and at first sight appear to be the anterior ventricles of the brain produced; but in man they are small, and without any discernible cavity. The reason of this is pretty evident, if we consider how this animal's head is situated; for the lymph continually gravitating upon the inferior part of the ventricles, may thus elongate and produce them: but from this very inferior part the olfactory nerves rise, and are sent immediately through the os ethmoides into the nose. Hence the ancients, thinking they were continued hollow into the nose, believed they were the emunctories of the brain: In the brain of sheep, which by its firm texture is the best subject of any for searching into the structure of this part, we evidently see, that the name of the *sigmoid cavity* was very properly applied by the ancients to the lateral ventricles of the brain; which are really of a greater extent than they are ordinarily painted by the anatomists, reaching farther backwards, and forwards again under the substance of the brain.

brain. The cortical and medullary parts, as well as the corpus calloſum, are ſimilar to thoſe parts in man.

The *nates* and *teſtes* deſerve this name much better here than in the human body, with reſpect to each other. They are larger in the quadruped; and hence we perceive that there is no great reaſon for aſcribing the different operations to any particular ſize or ſhape of theſe parts. They are here alſo of different colours; the *nates* being of the colour of the cortical, and the *teſtes* of the medullary ſubſtance of the brain; whereas in man they are both of one colour. The reaſon of theſe differences, and others of the like nature to be met with, I ſhall not pretend to determine; for we have hitherto ſuch an imperfect knowledge of the brain itſelf, that we are entirely ignorant of the various uſes of its different parts. We may in general conclude, that the varying in one animal, from what it is in another, is fitted to the creature's particular way of living.

The *rete mirabile Galeni*, ſituated on each ſide of the *ſella turcica*, about which there has been ſo much diſpute, is very remarkable in moſt quadrupeds. This plexus of veſſels is nothing elſe than a continuation of the internal carotid arteries, which, entering the ſkull, divide into a vaſt number of minute branches running along the ſide of the ſella turcica, and, uniting afterwards, are ſpent on the brain in the common way. Galen ſeems with juſtice to ſuppoſe, that this plexus of veſſels ſerves for checking the impetuoſity of the blood deſtined for the brain.

The ſtructure of the brain differing but very little in all quadrupeds, it will be needleſs to examine it in any other.

The

The MUSCLES of a DOG.

IN the following deſcription, it is not intended to give a complete account of the muſcles of the dog, but only of the particulars wherein they differ from thoſe of the human ſpecies; at the ſame time that care has been taken to make their names agree as near as poſſible with thoſe of modern authors.

It is alſo to be underſtood, that thoſe muſcles concerning which nothing is here ſaid, in general agree with thoſe of the human ſpecies.

PANNICULUS CARNOSUS.—Immediately below the ſkin lies a thin fleſhy expanſion, covering the greateſt part of the body, and ſurrounding the other muſcles. It runs over the head, neck, and greateſt part of the thorax and abdomen, and covers the whole of the back, ilium, ſacrum, and upper part of the thighs. From the thorax a ſlip runs over to the axilla, where it is collected into a thick fold that terminates in the latiſſimus dorſi. In man there is nothing ſimilar to this, excepting the platyſma myoides, or the occipto-frontalis. The uſe of this thin muſcle is to wrinkle the ſkin, in order to ſhake off duſt, inſect, &c. By this alſo the animal has a power, in ſome meaſure, of making the hair ſtand on end, particularly on the neck.

Muscles of the TEGUMENTS of the CRANIUM.

OCCIPITO-FRONTALIS. In man this is a diſtinct muſcle covering all the upper part of the head, beginning at the occiput, and ending at the under part of the brow. In a dog this is only part of the panniculus carnoſus; and therefore is common to the head and reſt of the body.

CORRUGATOR SUPERCILII wanting.

Muscles of the EAR.

The muſcles of the ear of this animal differ conſiderably from thoſe in the human ear, where little motion ſeems to have been intended. In a dog, the motions of the ear are free and extenſive; and hence a greater number of muſcles was required: But ſeveral of theſe are ſo ſmall, that perhaps it may be ſufficient to deſcribe two of the principal of them.

RETRAHENS, a large and diſtinct muſcle ariſing from the ſpinous proceſſes of the two or three firſt cervical vertebræ, and running over, to be fixed to the concha at its lateral and upper part. Its name denotes its uſe.

ERIGENS, ariſes from a ridge on the occipital bone, and runs over by three diſtinct fleſhy ſlips to be fixed to the outer part of the ear, and ſerving to erect or prick it up.

There are likewiſe a number of very diſtinct muſcles belonging to the internal ear.

LAXATOR TYMPANI is a ſhort muſcle, of an oval form and glandular appearance, lying in a particular cavity of the os petroſum, near the foramen ovale; from the bottom of which it ſprings, and is inſerted by a very ſlender tendon into the malleus. The uſe is, as in man, to relax the membrani tympani, by rendering it leſs concave.

Muſculus MEATUS AUDITORIUS. In a dog there are ſeveral ſmall muſcles which come from one of the protuberating cartilages of the concha, and end in another of them; which, by putting them nearer together or farther aſunder, may dilate or contract the meatus externus, the better to fit it for different ſounds.

Muscles of the EYE.

The muſcles which belong to the eye of a dog are ſimilar to thoſe in man; but, from the differ-

ence of ſituation of the head, the dog has an addition of two others not found in the human ſpecies.

All quadrupeds have a ſeventh muſcle belonging to the eye, called *ſuſpenſorius*. It ſurrounds almoſt the whole optic nerve, and is fixed into the ſclerotic coat as others are. Its uſe is to ſuſtain the weight of the globule of the eye, and to prevent the optic nerve from being too much ſtretched, without obliging the four ſtraight muſcles to be in a continual contraction, which would be inconvenient; at the ſame time this muſcle may be brought to aſſiſt any of the four, by cauſing one particular portion of it to act at a time.

Muſculus TROCHLEÆ PROPRIUS is by much the ſmalleſt muſcle of the eye. It ariſes fleſhy near the origin of the obliquus major; and ſoon ſends off a ſlender tendon, which is inſerted into the trochlea, to the motions of which it is ſubſervient.

Muscles of the FACE.

NOSE. The noſe of a dog has no proper muſcle, as in the human body; but is moved by muſcles which are common to it and to the reſt of the face.

MOUTH. The lips of a man are moved by nine pair of muſcles and a ſphincter; but a dog has only five pairs and the ſphincter.

LEVATOR ANGULI ORIS wanting.

LEVATOR LABII SUPERIORIS ariſes and is inſerted in the dog in a manner ſomewhat ſimilar to what it is in man. Its uſe is to pull up the lip, which the animal does principally in ſnarling.

DEPRESSOR ANGULI ORIS wanting.

DEPRESSOR LABII INFERIORIS ariſes from the middle of the lower jaw, and runs up to be fixed to the under lip.

ZYGOMATICUS MAJOR has many of its fibres

ſpread

ſpread out upon the buccinator muſcle, by which the corner of the mouth is forcibly drawn upwards.

ZYGOMATICUS MINOR wanting.

Muscles of the LOWER JAW.

TEMPORALIS ariſes and is inſerted almoſt in the ſame manner as in man; but is much thicker and ſtronger in proportion to the ſize of the animal; as indeed might be naturally expected, when we conſider the very hard and ſtrong ſubſtances which dogs are capable of breaking and tearing aſunder with their teeth.

MASSETER ariſes and is inſerted alſo ſomewhat in the ſame manner as in man; and, like the temporal muſcle, is thick and ſtrong, that the jaws may be brought more forcibly together.

PTERYGOIDEUS INTERNUS *et* EXTERNUS ariſe cloſe together from the ſphenoid bone, and are inſerted as in man.

Muscles about the NECK, THROAT, &c.

PLATYSMA MYOIDES. A dog has no proper platyſma myoides; but the panniculus carnoſus runs over the neck, and ſerves the ſame purpoſe.

STERNO-C-MASTOIDEUS. As the dog has no clavicle, this muſcle ariſes by one head from the top of the ſternum, and runs half-way up the neck, contiguous to its fellow on the other ſide; here it ſeparates from it, and runs up to be inſerted as in man.

DIGASTRICUS, in man, has two fleſhy bellies, with a tendon in the middle; but in the dog it ariſes by a very thick and ſtrong fleſhy belly, from between the maſtoid proceſs of the temporal and condyloid proceſs of the occipital bones, and runs forward to be fixed by a broad inſertion into the middle of the lower jaw. Its uſe is to counteract

the temporal and maſſeter muſcles by bringing down the jaw.

STERNO-HYOIDÆUS, in man, ariſes from the ſternum, firſt rib, and clavicle. In the dog, it ariſes, in common with the ſterno-thyroidæus muſcle, from the cartilaginous extremity of the firſt rib. After running along the neck a ſhort way, it leaves the ſterno-thyroid muſcle, and runs, as in man, to the baſe of the os hyoides.

OMO-HYOIDÆUS wanting.

STERNO-THYROIDÆUS ariſes in common with the ſterno-hyoidæus.

CHONDRO-CERATO-HYOIDÆUS ariſes from the ſuperior corner of the thyroid cartilage, and is inſerted into the cartilaginous appendix of the os hyoides. Its uſe is to draw theſe bodies cloſer together. In man this muſcle is wanting.

STYLO-GLOSSUS, in man, ariſes from the ſtyloid proceſs. In the dog it ariſes from the extremity of the long proceſs of the os hyoides; and therefore ought to be called *hyo-gloſſus*.

INIO-CERATO-HYOIDÆUS, a very ſhort fleſhy muſcle, ariſing from the head by the ſide of the digaſtric muſcle of the lower jaw; and is inſerted near the extremity of the long proceſs of the os hyoides, which it pulls backwards.

STYLO-HYOIDÆUS *alter*, wanting.

STYLO-PHARYNGÆUS ariſes from the extremity of the long proceſs of the os hyoides.

CIRCUMFLEXUS, or *tenſor palati*, ariſes from the beginning of the Euſtachian tube; adheres firmly to the ſoft part, where it becomes fleſhy; and afterwards ſends off a tendon which runs over the inner plat of the pterygoid proceſs of the ſphenoid bone. It is inſerted into the palatum molle, and likewiſe joins its fellow on the other ſide. The uſe of this muſcle is to pull the ſoft part of the palate from the poſterior part of the noſtrils, to compreſs the glands of the palate

which

which lie near it. It may likewiſe aſſiſt in dilating the ſoft part of the Euſtachian tube.

CONSTRICTOR ISTHMI FAUCIUM may not only ſerve the common purpoſes as in man, but likewiſe act upon a glandular body which is placed in the throat, near the amygdala.

AZYGOS UVULÆ. Although the uvula is wanting in this animal, a bundle of muſcular fibres runs through the middle of the palatum molle, ſomewhat in the ſame manner as in man.

HYO-EPIGLOTTIDÆUS. In man, the epiglottis is raiſed by the elaſticity of its cartilage; but in the dog there is a very diſtinct muſcle, which ariſes from the body and cartilaginous proceſs of the os hyoides, and runs down to be inſerted into the middle of the upper part of the epiglottis, near its top. Its uſe is to raiſe the epiglottis after ſwallowing.

MUSCLES of the ABDOMEN.

OBLIQUUS EXTERNUS DESCENDENS ariſes fleſhy, by nine or ten heads, from an equal number of poſterior ribs; membranous, from the ſpinous proceſſes of the four anterior lumbar vertebræ, and from the ſpine of the os ilium. From theſe different origins it runs over and downwards to the edge of the rectus muſcle. Here it forms the linea ſemilunaris, and is then continued over the rectus by a thin tendinous expanſion to be inſerted into the linea alba. A thin tendinous expanſion may be traced down with the chord.

OBLIQUUS ASCENDENS INTERNUS, at a little diſtance from the outſide of the rectus muſcle, becomes tendinous, and is continued ſo over the fore-part of that muſcle, to be fixed to the linea alba.

RECTUS ABDOMINIS ariſes fleſhy from the pubes, and runs up to be fixed to the under end of the ſternum; and about the 5th or 6th rib it ſends

off a tendinous expanſion, which covers the cartilages of the ribs, and is continued to the top of the ſternum. It has the ſame uſe as in man; but its under end being fleſhy, ſerves in ſome meaſure to make up for the

PYRAMIDALIS, which is wanting.

Muscles of the MALE PARTS of GENERATION.

The muſcles in general are thicker and ſtronger than in man, and there is an addition of three or four which are not found in the human ſpecies.

TRANSVERSALES ERPINÆI wanting.

TRANSVERSALIS, a ſmall, but diſtinct muſcle, which ariſes behind the erector penis from a ſmall protuberance at the under and poſterior part of the os pubis. It is inſerted with its fellow into a tendon between the os pubis and penis. This muſcle may aſſiſt in keeping the penis diſtended in time of copulation.

PRÆPUTIUM ADDUCENS ariſes from the panniculus carnoſus near the cartilago enſiformis; and runs along the ſide of the linea alba, to be fixed to the lateral part of the prepuce. Its uſe is to bring the prepuce forward over the glans, after an erection of the penis.

PREPUTIUM ABDUCENS is a ſingle muſcle which ariſes by a ſmall fleſhy belly from the ſphincter ani and accelerator urinæ; at the fore part of which it runs along the under ſide of the urethra, to be inſerted into the prepuce. Its uſe is to counteract the former muſcle.

MUSCULUS URETHRÆ ſurrounds that part of the urethra which lies between the proſtate gland and union of the crura penis. Its uſe is to compreſs that part of the mucous glands and urethra which it covers in time of coition.

Muſcles of the FEMALE ORGANS of GENERATION agree in general with thoſe of the human ſpecies.

MUSCLES

Muscles of the ANUS.

Sphincter ani surrounds the anus, as in man; but is much narrower, less force being required here from the horizontal situation of this animal.

Levator ani arises as in man; but divides into three or four portions, one of which runs into the tail, and assists in compressing it.

Muscles about the PELVIS, LOINS, &c.

Musculus parvus *in articulatione femoris situs* arises near the upper edge of the acetabulum, and runs over the capsular ligament of the joint, to be fixed to the os femoris between the vastus internus and cruræus. Its use is to assist the obturator externus in the rotation of the thigh.

Musculi caudæ. The tail of this animal, which is made up of many joints, has several muscles fixed into it. They begin with fleshy bellies, which soon send off long tendons; some of which run as far as the extremity of the tail, and serve to give it its different motions which are upwards, downwards, and to each side; or, by a succession of these motions, the animal can roll its tail.

Quadratus lumborum is a small slender muscle; the anterior and upper end of which is contiguous to the psoas parvus; the posterior end to the psoas magnus. It arises from the spine of the ilium internally; and, ascending, is inserted into the transverse processes of all the lumbar vertebræ, and likewise into the 9th or 10th rib.

Psoas parvus, a large distinct muscle, which is constantly present, arising from the four lowest vertebræ of the back and as many of the loins, soon forming a fleshy belly, which sends off a broad expansion that runs by the inside of the psoas magnus; part of which it covers and conceals. At last

laſt it is fixed, as in man, to the brim of the pelvis.

Muscles ſituated on the THORAX.

Pectoralis major in a dog, differs from that in man, in being divided into three diſtinct parts. The firſt ariſes from the upper part of the ſternum; and, paſſing over the third, is inſerted under it by a ſtrong broad tendon into the whole length of the external and fore part of the os humeri. The ſecond ariſes from the under end of the ſternum and cartilago enſiformis, and covers a conſiderable ſhare of the under part of the next muſcle. It is inſerted partly with the next muſcle, and partly runs down upon the muſcles on the humerus. The third, and by much the broadeſt part, ariſes from the cartilago enſiformis and all the ſternum. It is inſerted into the head of the os humeri.

Subclavius wanting, as the dog has no clavicle.

Pectoralis minor wanting.

Serratus major anticus, ariſes fleſhy from the five poſterior tranſverſe proceſſes of the vertebræ of the neck, tendinous and fleſhy from the ſeven anterior ribs; from the neck it runs obliquely downwards, from the ribs it runs obliquely upwards. It is inſerted into the poſterior angle of the ſcapula internally. It may pull the ſcapula upwards, downwards, and backwards.

Sterno-coſtalis, in a dog, is much larger and ſtronger than in man; of conſequence it may act more powerfully on the thorax.

Longus colli, in a dog, is much more diſtinct in every reſpect than in man, its fleſhy bellies being divided by tendinous lines equal in number to the vertebræ of the neck.

Rectus capitis internus major ariſes by a number of tendinous and fleſhy beginnings from the

the tranſverſe proceſſes of all the vertebræ of the neck except the firſt; over the inſide of which it is reflected in its paſſage to the head. It is inſerted in a ſmall cavity in the cuneiform proceſs of the occipital bone.

Muscles ſituated on the POSTERIOR PART of the TRUNK.

Trapezius ariſes from the ligamentum nuchæ and vertebræ of the back. It is inſerted into all the ſpine of the ſcapula except its fore-part, where it unites with the levator ſcapulæ major.

Latissimus dorsi is membranous as far as the under part of the thorax, and is afterwards covered as in man by the cucularis. When it arrives at the teres major, it parts with a thin fleſhy production, which, running down upon the long head of the triceps, is inſerted tendinous into the elbow. A little before this, it receives the continuation of the panniculus carnoſus.

Serratus posticus inferior ariſes by a thin tendon from the poſterior part of the ligamentum nuchæ, and from the ſpinous proceſſes of the eight anterior vertebræ of the back. It is inſerted into the anterior ribs excepting the firſt, by as many fleſhy indentations. Its tendon joins with that of the ſerratus poſticus inferior; and with it makes a tendinous ſheath which keeps the ſubjacent muſcles together, and ſtrengthens them in their action.

Longissimus dorsi is ſimilar to that in man, but much ſtronger, as well as the ſacro-lumbalis.

Complexus ariſes from the tranſverſe proceſſes of the four anterior vertebræ of the back by as many ſmall tendons, from the poſterior vertebræ of the neck by as many different heads, which, uniting, form a fleſhy belly which is inſerted into the occipital bone near its ridge.

Trachelo-mastoideus, a little before it reaches

reaches the head is firmly united to the ſplenius muſcle.

LEVATOR SCAPULÆ MAJOR ariſes fleſhy from the tranſverſe proceſs of the firſt vertebra of the neck, and runs along the ſide of the neck to be inſerted in common with the cucularis into the ſpine the ſcapula.

LEVATOR SCAPULÆ MINOR ariſes tendinous from the occipital bone, runs down the back part of the neck, and in its paſſage joins the long portion of the rhomboid muſcle, to be inſerted by a long tendon into the baſe of the ſcapula near its angle. The two ſerve to raiſe the ſcapula; the anterior may raiſe the fore-part, and the poſterior the back-part.

MULTIFIDUS SPINÆ, in general, agrees with that in man, but the upper part of it is inſerted into the bodies of the cervical vertebræ.

RECTUS. In the dog there are three recti muſcles.

Rectus major ariſes from the ſpinous proceſs of the ſecond vertebra of the neck, and runs ſtraight forward, covering the rectus medius.

Rectus medius ariſes from the upper part of the ſame proceſs, and is inſerted with the former.

Rectus minor the ſame as in man.

OBLIQUUS CAPITIS SUPERIOR, like the rectus major, is alſo double. One part ariſes from the extremity of the tranſverſe proceſs of the firſt vertebra of the neck, the other from its upper edge; and both are inſerted into the occipital bone.

SCALENUS, as in man, may be divided into three muſcles; but the ſcalenus medius is broader, and is inſerted into the fifth or ſixth rib.

MUSCULUS IN SUMMO THORACE SITUS ariſes fleſhy from the firſt rib; and afterwards turns tendinous to be inſerted into the ſternum, under the tendon of the rectus abdominis.

In-

INTERTRANSVERSALIS COLLI is much thicker and ſtronger than in man.

MUSCLES of the SUPERIOR EXTREMITIES.

INFRASPINATUS has the middle tendon and penniform appearance much more diſtinct than in man.

TERES MINOR ariſes by a ſlender tendon, which adheres forwards to the under edge of the infraſpinatus; then it forms a fleſhy belly, which paſſes obliquely over the beginning of the long head of the biceps muſcle, to be inſerted into the head of the os humeri.

DELTOIDES ariſes tendinous from almoſt all the ſpine of the ſcapula. That part which comes from the acromion ſeems to be diſtinct from its other origin, but cannot be divided from it without violence. Its action is upwards and outwards; for it has no beginning from the clavicle to move it inwards.

CORACO-BRACHIALIS is a ſmall muſcle ariſing from the upper part of the ſuperior coſta ſcapulæ by a very ſlender tendon; which, paſſing over the head of the humerus, grows fleſhy, and is inſerted into the inſide of that bone about an inch or more below its neck.

SUBSCAPULARIS poſſeſſes only about three parts of the ſurface of the ſcapula, the ſerratus magnus poſſeſſing the reſt.

Beſides the muſcles already deſcribed, the dog has two others peculiar to himſelf.

LEVATOR HUMERI PROPRIUS riſes from all the ſpace between the tendinous end of the maſtoid muſcle and ridge of the occiput, from the anterior part of the ligamentum nuchæ. This large beginning contracts and grows narrower as it runs obliquely along the neck, cloſely adhering to ſome part of the levator ſcapulæ major; and, paſſing over the articulation of the humerus, goes ſtraight

down

down to its inſertion in the fore, and near the under part of the ſame bone.

MUSCULUS AD LEVATOREM ACCESSORIUS, ariſes from the os occipitis near the inſertion of the maſtoid muſcle, and unites with the former a little before it reaches the ſcapula. Juſt above the head of the os humeri, near the termination of the muſcle, there is placed a ſmall crooked body, of a cartilaginous nature, tied to the ſcapula and top of the ſternum by two ſmall ligaments; which is all that the animal can be ſaid to have for a clavicle. In cats, this muſcle is inſerted into the whole length of the clavicle, which it ſerves to raiſe: but in this animal the uſe of the acceſſory muſcle ſeems calculated for the aſſiſtance of the levator, which ſerves to raiſe the os humeri, and to turn it a little outwards, whereby the fore-feet are kept from injuring each other in running or leaping.

BICEPS, in this animal, ought to be diſtinguiſhed by ſome other name, as *flexor cubiti anterior*. It riſes here by one head from the ſcapula, and runs down above the following muſcle to be inſerted by two tendons as in man.

BRACHIALIS INTERNUS riſes broad and fleſhy from the back of the humerus under its neck, and runs down by the outſide of the former muſcle.

The extenſion of the cubit or fore-arm is performed by the action of five muſcles.

EXTENSOR PRIMUS, and what correſponds with the long head of the triceps in man, becomes very thick and fleſhy; but afterwards ſends off a tendon, which is inſerted into the olecranon.

EXTENSOR SECUNDUS, correſponding with the ſhort head of the triceps, ariſes from the ſuperior and back part of the humerus, and, deſcending under the former, ſends off a tendon through a ſulcus in the extremity of the ulna, and is inſerted below the other muſcles.

EXTENSOR TERTIUS, ſomething analogous to

the brachæus externus in man, ariſes from the upper and back part of the humerus as a protuberance near the termination of the teres minor, to be inſerted into the outſide of the olecranon.

EXTENSOR QUARTUS, or *anconæus*, fills up a cavity or hollow between the heads of the radius and ulna, and has the ſame origin and termination as in man.

EXTENSOR QUINTUS ariſes by a thin tendon from the inſide of that protuberance into which the ſupraſpinatus of the ſcapula is inſerted; and paſſing under the tendon of the teres major, ends at the inſide of the olecranon.

PALMARIS LONGUS wanting.

——— BREVIS wanting.

FLEXOR CARPI ULNARIS.—Here we find two diſtinct muſcles. The

Large ariſes from the internal condyle of the os humeri near the edge of the ſinus that receives the head of the ulna, and is inſerted into the carpus. The

Smaller ariſes fleſhy from the olecranon, and runs down by the ſide of the former to terminate with it in the carpus.

EXTENSOR CARPI RADIALIS LONGIOR *et* BREVIOR, ſimilar to thoſe in man, but more firmly united together at their origin.

EXTENSOR CARPI ULNARIS ſends a tendon to the carpus, which pulls that part out in extenſion, and aſſiſts the animal in running.

FLEXOR SUBLIMIS PERFORATUS. The openings through the tendons of this muſcle for the paſſage of the next, are much larger and wider than in man, and the tendons terminate without any ſubdiviſion.

FLEXOR PROFUNDUS PERFORANS ariſes from the os humeri, radius, and ulna, by three diſtinct heads, which unite, and afterwards ſend off a ſtrong tendon, which ſplits into five ſmall ones;

four of which terminate as in man; the fifth is inſerted into the part which correſponds with the thumb.

EXTENSOR DIGITORUM COMMUNIS runs to the laſt bone of each toe between the two ligaments that go from the ſecond bone of the toe to the third. The uſe of theſe ligaments is to draw the laſt joint backwards and upwards, and keep it ſuſpended, that the extending tendon may not always be upon the ſtretch.

SUPINATOR RADII LONGUS wanting.

PRONATOR RADII QUADRATUS lies upon the membrane that joins the two bones of the cubit together, to both of which it adheres; and near the under end of the ulna ſends off a tendon obliquely to the extremity of the radius, into which it is inſerted.

INDICATOR ariſes as in man, but is inſerted into the laſt joint of what correſponds with the fore-finger.

ABDUCTOR INDICIS MANUS wanting.

FLEXOR PRIMI INTERNODII wanting.

EXTENSOR TERTII INTERNODII wanting.

INTEROSSEI.——A dog has interoſſei muſcles ſomewhat ſimilar to thoſe in man, and they are ſix in number; four of which are large, and placed, not between, but in the hollow of the metacarpal bones, and run ſtraight down. The other two are very ſmall, and run oblique. The large ariſe tendinous and fleſhy from the ſuperior part of the metacarpal bones, adhering to the ſame in their deſcent: at the os ſeſamoideum of the firſt joint, each divides into two tendons; which running obliquely along the ſides of the toe, unite inſeparably with the tendon of the extenſor near the lower part of the firſt bone of each toe.

The firſt of the two ſmall muſcles belongs to the fore-toe or index. It ariſes from the upper part of the os metacarpi medii digiti; and, deſcending obliquely,

obliquely, grows tendinous about the firſt joint, and terminates near the middle of this bone internally.

The ſecond ariſes from the os metacarpi of the third toe; and after running obliquely, ends in the inſide of the firſt bone of the little toe. The uſe of theſe two muſcles is to bring theſe two toes nearer the middle one.

ABDUCTOR INDICIS wanting.

FLEXOR PRIMI INTERNODII wanting.

Muscles of the INFERIOR EXTREMITIES.

PSOAS MAGNUS.

PECTORALIS, from the os pubis.

Beſides the TRICEPS ADDUCTOR FEMORIS, a dog has a MUSCULUS PARVUS IN ARTICULATIONE FEMORIS SITUS, which ariſes from the ſide of the acetabulum, and is inſerted into the upper inner part of the os femoris, after running over the capſular ligament of the joint.

GLUTÆUS MEDIUS here, ought rather to be called *glutæus maximus*. The principal difference between the glutæi muſcles and thoſe of man is, that the glutæus maximus is by much the largeſt.

TENSOR VAGINÆ FEMORIS is divided into two diſtinct muſcles. The ſuperior ariſes from the ſpine of the os ilium, and ends as in man. The inferior ariſes from below the former, and with it is inſerted into the ſame tendon.

A dog has the addition of a FIFTH EXTENSOR, which ariſes from the ſpine and half the coſta of the os ilium. In its deſcent it adheres to the ſartorius by a membrane, and is inſerted into the patella.

BICEPS FLEXOR CRURIS nearly as in man, excepting that its ſhort head is much ſmaller.

GASTROCNEMIUS has but two heads; whereas in man it has four.

PLANTARIS ariſes in common with the flexor digitorum communis.

TIBIALIS ANTICUS ſends off a tendon which runs upon the great toe, which it ſerves to extend.

TIBIALIS POSTICUS, a very ſmall muſcle when compared with that in man.

EXTENSOR LONGUS DIGITORUM ariſes by a round tendon from the fore-part of the external condyle of the os femoris; and deſcending thro' a ſinus in the head of the tibia, grows fleſhy after paſſing under the ligament ſimilar to that of the tarſus in man. Inſerted into the ends of the toes.

EXTENSOR BREVIS DIGITORUM may be ſaid to be two diſtinct muſcles. The firſt ariſes tendinous, the other fleſhy for the os calcis. The firſt ſoon becomes fleſhy, and afterwards ſends off a tendon, which ends in the toe next the great one. The ſecond, or outermoſt, gives tendons to the reſt of the toes.

FLEXOR BREVIS DIGITORUM ariſes from the lower part of the os femoris, and runs under the gaſtrocnemius, to which it adheres. It afterwards runs over the os calcis, and ſplits into four tendons, which give paſſage to the following muſcle.

FLEXOR LONGUS DIGITORUM ſplits into five tendons: one runs to the great toe; the reſt run through the tendons of the former to the other toes.

FLEXOR DIGITORUM ACCESSORIUS wanting.

EXTENSOR PROPRIUS POLLICIS. Somewhat ſimilar to that in man; but, beſides it, there is a tendon ſent off from the lower part of the tibialis poſticus, which runs along the upper part of this toe, and aſſiſts in extending it.

FLEXOR BREVIS POLLICIS, in this animal, is a thin ſlip ſent off from the flexor profundus.

AB-

ABDUCTOR POLLICIS wanting.
ADDUCTOR POLLICIS wanting.
ABDUCTOR MINIMI DIGITI wanting.
FLEXOR BREVIS MINIMI DIGITI wanting.
INTEROSSEI. The hind-foot, like the fore-one, has six muſcles, four of which are ſtraight, the other two oblique; and the whole of them ſerve the ſame purpoſe as the interoſſei in man.

Muscles peculiar to MAN.

Pyramidales.
Corrugator ſupercilii.
Compreſſor naris.
Levator anguli oris.
Depreſſor anguli oris.
Omo-hyoidæus.
Levator palati.
Palato-pharyngæus.
Subclavius.
Pectoralis minor.
Supinator longus.
Palmaris longus.
Palmaris brevis.
Prior indicis.
Abductor indicis.

All the muſcles of the thumb, excepting one flexor and one extenſor.

All the muſcles of the little finger, excepting the extenſor.

Coccygæus.

Muscles peculiar to the DOG.

Tranſverſalis penis.
Muſculus oculi ſuſpenſorius.
Muſculus trochleæ proprius.
Several muſcles of the ear.
Chondro-cerato-hyoidæus.
Inio-cerato-hyoidæus.
Hyo-glottis.

Tympano-palatinus.
Muſculus in ſummo thorace ſitus.
Levator ſcapulæ minor.
Panniculus carnoſus.
Levator humeri proprius.
Muſculus ad levatorem acceſſorius.
Extenſor cubiti quintus.
A ſecond flexor carpi ulnaris.
Muſculus parvus in articulatione ſitus.
Muſculi caudæ.
Extenſor tibiæ quintus.
Præputium adducens.
Præputium abducens.
Muſculus urethræ.

The ANATOMY of a COW.

THE next ſpecies of quadrupeds we propoſed to conſider, was the ruminant kind, of which we have an example in a cow; and accordingly ſhall take the fœtus of the animal *in utero*, that we may firſt remark ſome things that are peculiar to it in that ſtate, and afterwards proceed to examine its viſcera as a ruminant animal. Firſt, then, as a fœtus.—However, before we begin our inquiry, it may be worth our obſervation, that from the ovarium ſomething eſſentially neceſſary for the production of the fœtus is derived, as well as in the human ſpecies.

The form of a cow's *uterus* differs from the human, in having two pretty large cornua. This is common to it with other brutes; for a bitch has two long *cornua uteri*: But theſe again differ (as being multiparous and uniparous) in this, that in the bitch's cornua the fœtuſes are contained; whereas here there is only part of the ſecundines, being moſtly the allantois with the included liquor. The muſcular fibres of the uterus are more

eaſily

eaſily diſcovered; its internal ſurface has a great number of ſpungy, oblong, protuberant, glandular bodies fixed to it. Theſe are compoſed of veſſels of the uterus terminating here. In an impregnated uterus, we can eaſily preſs out of them a chylous mucilaginous liquor; they are compoſed of a great many proceſſes or digituli, and deep caverns, anſwering to as many proceſſes and caverns of the placenta. Their reſemblance has occaſioned the name of *papillæ* to be given them; and hence it was that Hippocrates was induced to believe that the fœtus ſucked *in utero*. The papillæ are found in all the different ſtages of life, in the various ſtages of pregnancy, and likewiſe in the unimpregnated ſtate. It is not eaſy to determine whether the uterus grows thicker or thinner in the time of geſtation. The membranes, it is plain, (by the ſtretching of the parts), muſt be made thinner; but then it is as evident, that the veſſels are at that time enlarged, upon which principally the thickneſs of any part depends; ſo there ſeems to be as much gained the one way as loſt the other.

The *os uteri* is entirely ſhut up by a glutinous mucilaginous ſubſtance, that is common to the females of all creatures when with young: by this the external air is excluded, which would ſoon make the liquors corrupt; it alſo prevents the inflammation of the membranes, and the hazard of abortion. By this means alſo the lips of the womb are kept from growing together, which otherwiſe they would certainly at this time do. There are mucous glands placed here to ſecern this gluten, which on the breaking of the membranes with the contained waters make a ſapo that lubricates and waſhes the parts, and makes them eaſily yield. The firſt of the proper involucra of the fœtus is the chorion.

The *chorion* is a pretty ſtrong firm membrane, on

on whoſe external ſurface are diſperſed a great many red fleſhy bodies of the ſame number, ſize and ſtructure with the papillæ, with which they are mutually indented. They have been called *cotyledones*, from Κοτυλη, "cavity." This is greatly diſputed by ſome as a name very improper; but I think without reaſon, ſince the ſurface that is connected to the papillæ is concave, though when ſeparated it appears rather convex. To ſhun all diſpute, they may be called properly enough *placentulæ*, ſince they ſerve the ſame uſe as the placenta in women. The ſeparation of theſe from the papillæ without any laceration, and our not being able to inject coloured liquors from the veſſels of the glands of the uterus into the placentulæ, ſeem to prove beyond a reply, that there can be here no anaſtomoſes betwixt the veſſels; on their coats run a great number of veſſels that are ſent to the ſeveral placentulæ, on the external ſide next to the uterus; whereas in creatures that have but one placenta, as in the human ſubject, cats, dogs, &c. the adheſion is ſomewhat firmer: The placentæ are likewiſe joined to the papillæ in the cornua uteri. We ſhall next give the hiſtory of the *allantois*.

This is a fine tranſparent membrane contiguous to the former. It is not a general involucrum of the fœtus in the mother, for it covers only a ſmall part of the amnios. It is moſtly lodged in the cornua uteri. In mares, bitches, and cats, it ſurrounds the amnios, being every-where interpoſed betwixt it and the chorion. In ſheep and goats it is the ſame as in this animal; and in ſwine and rabbits it covers ſtill leſs of the amnios. This ſac is probably formed by the dilatation of the urachus, which is connected at its other end to the fundus of the bladder, through which it receives its contents; and a great quantity of urine is commonly found in it. The membrane is doubled at

the

the extremity of the canal, to hinder the return of the urine back into the bladder. Its veſſels are ſo exceſſively fine and few, that we cannot force an injected liquor farther than the beginning of this coat. This membrane is ſo far analagous to the cuticula, as not to be liable to corruption, or eaſily irritated by acrid liquors. The exiſtence of this membrane in women has been very warmly diſputed on both ſides. Thoſe who are againſt its exiſtence deny they could ever find it; and, allowing it were ſo, allege, that ſince the urachus is impervious, as appears by our not being able to throw liquors from the bladder into it, or *vice verſa*, it cannot ſerve the uſe that is agreed by all it does ſerve in beaſts; and therefore in the human body there is no ſuch thing. But when I conſidered on the other hand, firſt, that there ſeems to be the ſame neceſſity for ſuch a reſervoir in man as in other animals: ſecondly, that we actually find urine contained in the bladder of the human fœtus: thirdly, that urine has been evacuated at the navel when the urethra was ſtopped, which urine without this conduit would have fallen into the cavity of the abdomen: fourthly, that midwives have pretended to remark two different ſorts of waters come away at the time of birth: and laſtly, that Dr Littre and Dr Hale have given in this membrane of an human ſubject, with all the other ſecundines curiouſly prepared, the one to the royal academy at Paris, the other to the royal ſociety at London; by which ſocieties their reſpective accounts are atteſted; not to mention Verheyen, Heiſter, Keill, &c. who affirm their having ſeen it; and Mr Albinus, that famous anatomiſt, profeſſor at Leyden, ſhows, as I am told, to his college every year a preparation of it: On all theſe accounts I muſt own, that it ſeemed not improbable to me there was ſuch a membrane in the human body. But in four bodies I purpoſely

poſely diſſected, wherein I was aſſiſted by a very accurate anatomiſt, Dr Sinclair, I could not obſerve any ſuch thing. However, my want of ſkill will more probably be doubted, than the truth of relations, ſupported by ſuch authentic vouchers, called in queſtion.

The third proper integument of the fœtus is the *amnios*. It is thinner and firmer than the chorion; it has numerous ramifications of the umbilical veſſels ſpread upon it, the lateral branches of which ſeparate a liquor into its cavity. This is the proper liquor of the amnios: which at firſt is in a ſmall quantity, afterwards increaſes for ſome months, then again decreaſes; and in a cow near her time, the quantity of this liquor is not above a pound. This membrane does not enter the *cornua uteri* in this creature, being confined to the body of the uterus; whereas the allantois occupies chiefly its cornua. But for what further relates to the ſtructure of the involucra, with the nature of the liquors contained in them, I muſt refer to the ſecond volume of Medical Eſſays, from page 121, where you have the ſum of all I know of this matter.

There are here two *venæ umbilicales*, and but one in the human ſubject; becauſe the extreme branches coming from the ſeveral placentulæ could not unite ſo ſoon as they would have done had they come all from one cake as in the human.

There is a ſmall round fleſhy body that ſwims in the urine of this creature, mares, &c. which is the *hippomanes* of the ancients. Several idle opinions and whims have been entertained as to its uſe; but that ſeems to be ſtill unknown, or how it is generated or nouriſhed, for it has no connection with the fœtus or placentulæ.

Having thus conſidered the ſeveral involucra of this animal in a fœtus ſtate, let us next obſerve the

the ſpecialties in its internal ſtructure peculiar to a fœtus.

The umbilical vein joins the *vena portarum* in the *capſula Gliſſoniana*, without ſending off any branches as it does in the human ſubject. This vein ſoon after birth turns to a ligament; yet there are ſome inſtances where it has remained pervious for ſeveral years after birth, and occaſioned a hæmorrhage. We may next obſerve the duct called *canalis venoſus*, going ſtraight from the *capſula Gliſſoniana* to the *vena cava*; this turns alſo afterwards to a ligament. The umbilical arteries riſe at acute angles from the internal iliacs, whatever ſome may ſay to the contrary; theſe alſo become impervious.

The pulmonary artery coming from the right ventricle of the heart divides into two; the ſmalleſt, called *canalis arterioſus*, opens into the deſcending aorta; the other divides into two, to ſerve the lungs on each ſide. The *foramen ovale* is placed in the partition betwixt the right and left auricles. At the edge of the hole is fixed a membrane, which when much ſtretched will cover it all over; but more eaſily yields to a force that acts from the right auricle to the left, than from the left to the right. After what has been ſaid, we may eaſily underſtand how the circulation is performed in a fœtus. The blood, being brought from the placenta of the mother, is thrown into the *capſula Gliſſoniana*, where it is intimately blended with the blood in the *vena portarum*: then part of this blood goes directly into the *vena cava* by the *ductus venoſus*; the reſt paſſes thro' the liver. Firſt, then, the whole is ſent from the *vena cava* into the right auricle, from whence part of it is ſent by the *foramen ovale* into the left auricle; the reſt paſſes into the right ventricle, then into the pulmonary artery; then the greateſt ſhare it receives is ſent immediately into the deſcending

aorta

aorta by the *canalis arteriosus*, and the remainder circulates through the lungs, and is sent back by the pulmonary veins into the left auricle; which, with the blood brought there by the *foramen ovale*, is sent into the left ventricle, from whence it is driven by the aorta through the body. The great design of this mechanism is, that the whole mass of blood might not pass through the collapsed lungs of the fœtus; but that part of it might pass through the *foramen ovale* and *canalis arteriosus*, without circulating at all through the lungs.

This was the opinion that universally prevailed till the end of the last century, when it was violently opposed by Monsieur Mery, who is very singular in several of his opinions. He will not allow that the foramen ovale transmits blood from the right to the left auricle, but on the contrary from the left to the right; and that for no other reason but because he observed the pulmonary artery in a fœtus longer than the aorta. Mr Winslow endeavours to reconcile these two opinions, by saying the blood may pass either way, and that it is here as it were blended: his reason is, that on putting the heart in water, the foramen ovale transmits it any way. Mr Rohault, professor of anatomy at Turin, and formerly one of Mery's scholars, strongly defends his master, and criticises Mr Winslow. What he principally builds on, is the appearance this foramen has in some dried preparations: This Mr Winslow will not allow as a proof. After all, I remain in the common opinion; and that for the following reasons: First, the pulmonary artery being larger signifies nothing, since its coats are not only thinner and will be more easily distended, but also the resistance to the blood in the pulmonary artery from the collapsed lungs is greater than the resistance to the blood in the aorta. Secondly, if we should allow any of these two uncommon opinions,

nions, we ſhould have the right ventricle vaſtly more capacious than the left: For if we ſuppoſe the *foramen ovale* to be capable of tranſmitting one-third of the whole maſs of blood in any given time, and the *arteriosus* as much in the ſame time, then you will find, that, according to Mr Mery's opinion, the whole maſs of blood being driven from the right ventricle into the pulmonary artery, one-third paſſes by the *canalis arteriosus* into the deſcending aorta, two-thirds paſſing through the lungs and returning into the left auricle; one half of which portion, or one-third of the whole maſs, paſſes by the *foramen ovale* into the right auricle; and the other, or the laſt third, will be ſent into the left ventricle, and thence expelled into the *aorta*; which third, with that from the pulmonary artery by the *canalis arteriosus*, circulating through the body, are returned unto the right auricle, where meeting with the other third from the *foramen ovale*, with it they are ſent into the right ventricle to undergo the ſame courſe. Thus the whole maſs is expelled by the right ventricle, and only one-third by the left. If this was the caſe, why is not the right ventricle three times as large and ſtrong as the left?

Then if, according to Mr Winſlow's ſyſtem, the *foramen ovale* tranſmits equal quantities from both auricles, this comes to the ſame as if there was no *foramen ovale* at all: that is to ſay, the whole maſs going from the right auricle into the right ventricle and pulmonary artery, one-third of the whole maſs paſſes into the aorta through the *canalis arteriosus*; the other two-thirds, paſſing through the lungs, return to the left auricle and ventricle. Thus the right ventricle expels the whole maſs; the left, only one-third.

But if, according to the common opinion, we ſuppoſe the *foramen ovale* to convey the blood from the right to the left auricle, then one-third paſſes

this way into the left ventricle; the other two-thirds are ſent by the right ventricle into the pulmonary artery: from whence one-third paſſes by the *canalis arterioſus* into the *aorta deſcendens*; the other third circulates through the lungs, and is returned into the left ventricle; where meeting with that from the *foramen ovale*, it is therewith expelled into the aorta, and with the one-third tranſmitted by the *canalis arterioſus* returns into the auricle to run the ſame race as before. Thus we conclude, that two-thirds are expelled by each ventricle, and the whole circulates through the body; and hence they come to be of pretty equal dimenſions. In all this calculation I have had no regard to the blood diſcharged from the umbilical veſſels; but the greater quantity returned by the veins, than ſent out by the arteries, ſtill argues for the common opinion.

The *kidneys* in the fœtus are compoſed of different lobes, which ſerve to give us an idea of the kidneys being a congeries of different glands; theſe lobes being kept contiguous by the external membrane, are preſſed by the other viſcera, till at length they unite.

We now come to conſider the creature as a ruminant animal. There are no *dentes inciſores* in the upper jaw; but the gums are pretty hard, and the tongue rough. This roughneſs is occaſioned by long ſharp-pointed papillæ, with which the whole ſubſtance of it is covered. Theſe papillæ are turned towards the throat; ſo that by their means the food, having once got into the mouth, is not eaſily pulled back. The animals therefore ſupply the defect of teeth by wrapping their tongue round a tuft of graſs; and ſo, preſſing it againſt the upper jaw, keep it ſtretched, and cut it with the teeth of the under jaw; then, without chewing, throw it down into the œſophagus, which in theſe creatures conſiſts of a double row

of

of ſpiral fibres decuſſating one another. All animals which ruminate muſt have more ventricles than one; ſome have two, ſome three, our preſent ſubject has no leſs than four. The food is carried directly down into the firſt, which lies upon the left ſide, and is the largeſt of all; it is called γαστηρ, *ventriculus*, and κοιλια, by way of eminence. It is what is called by the general name of *paunch* by the vulgar. There are no rugæ upon its internal ſurface; but inſtead of theſe there are a vaſt number of ſmall blunt-pointed proceſſes, by which the whole has a general roughneſs, and the ſurface is extended to ſeveral times the ſize of the paunch itſelf. The food, by the force of its muſcular coat, and the liquors poured in here, is ſufficiently macerated; after which it is forced up hence by the œſophagus into the mouth, and there it is made very ſmall by maſtication: this is what is properly called *chewing the cud*, or *rumination*; for which purpoſe the *dentes molares* are exceedingly well fitted: for inſtead of being covered with a thin cruſt, the enamel on them conſiſts of perpendicular plates, between which the bone is bare, and conſtantly wearing faſter than the enamel, ſo that the tooth remains good to extreme old age; and by means of theſe teeth the rumination is carried on for a long time without any danger of ſpoiling them. After rumination, the food is ſent down by the gullet into the ſecond ſtomach; for the œſophagus opens indifferently into both. It ends exactly where the two ſtomachs meet; and there is a ſmooth gutter with riſing edges which leads into the ſecond ſtomach, from thence to the third, and alſo to the fourth: however, the creature has a power to direct it into which it will. Some tell us, that the drink goes into the ſecond; but that might be eaſily determined by making them drink before ſlaughter. The ſecond ſtomach, which is the anterior and

ſmaller, is called κηρυθρακοε, *reticulum*, *honeycomb*, the *bonnet*, or *king's-hood*. It conſiſts of a great number of cells on its internal ſurface, of a regular pentagonal figure, like to a honeycomb. Here the food is farther macerated; from which it is protruded into the third, called ἐχινος or *omaſum*, *vulgo* the *manyplies*, becauſe the internal ſurface riſes up into a great many plicæ or folds, and *ſtratum ſuper ſtratum*, according to the length of this ſtomach. Some of theſe plicæ are farther produced into the ſtomach than others; *i. e.* firſt two long ones on each ſide, and within theſe two ſhorter in the middle, &c. There are numberleſs glandular grains like millet-ſeeds diſperſed on its plicæ, from which ſome authors call this ſtomach the *millet*. From this it paſſes into the fourth, whoſe names are κυστον, *abomaſum*, *caillè*, or the *red*, which is the name it commonly has becauſe of its colour. This much reſembles the human ſtomach, or that of a dog; only the inner folds or plicæ are longer and looſer: and it may alſo be obſerved, that in all animals there is only one digeſtive ſtomach, and that has the ſame coagulating power in the fœtus as the fourth ſtomach in this animal; whence this might not improperly be called the only true ſtomach. *Caillè* ſignifies *curdled*; and hence the French have given that as a name to this fourth ſtomach, becauſe any milk that is taken down by young calves is there curdled. It is this fourth ſtomach, with the milk curdled in it, that is commonly taken for making runnet; but after the bile and pancreatic juice enter, this coagulation is not to be found, which ſhews the uſe of theſe liquors. There are other creatures which uſe the ſame food, that have not ſuch a mechaniſm in their digeſtive organs. Horſes, aſſes, &c. have but one ſtomach, where graſs is macerated, and a liquor for their nouriſhment extracted, and the remainder ſent out by the anus

very

very little altered. From this different ſtructure of the ſtomach in theſe creatures, a ruminant animal will be ſerved with one-third leſs food than another of equal bulk: graſiers are ſufficiently acquainted with this. The reaſon is, that ruminating animals have many and ſtrong digeſtive organs; all their food is fully prepared, and almoſt wholly converted into chyle: But a horſe's ſtomach is not fitted for this; ſo that he requires a much greater quantity of food to extract the ſame nouriſhment.

The guts of theſe creatures are of a conſiderable length in proportion to the bulk of the body; and this confirms what we ſaid formerly on the ſubject of the inteſtines of a dog, viz. that the length and capacity of the guts were different in different animals, according to the nature of their food.

The *duodenum* is formed here much the ſame way as in a dog, and the general intention kept in view with regard to the mixture of the bile and pancreatic lymph. The great guts here hardly deſerve that name, their diameter differing very little from that of the ſmall ones; but to compenſate this, they are much longer proportionally than a dog's are, being convoluted as the ſmall guts are. The cæcum is very large and long. The digeſtion of the cow, as well as ſome other animals, is accompanied with a peculiar kind of action called *rumination*; the intention of which ſeems to be, that the food may be ſufficiently comminuted, and thus more fully acted upon by the ſtomach: for it is not obſerved that a calf ruminates as long as it is fed only upon milk, though the action takes place as ſoon as it begins to eat ſolid food. But it is to be obſerved, that as long as a calf feeds only upon milk, the food deſcends immediately into the fourth ſtomach (which, as has been already mentioned, ſeems only capable of performing the ope-

ration of digeſtion) without ſtopping in any of the firſt three. The rumination does not take place till after the animal has eaten a pretty large quantity: after which ſhe lies down, if ſhe can do it conveniently, and begins to chew; though the operation will take place in a ſtanding poſture, if ſhe cannot lie down. In this action a ball is obſerved to riſe from the ſtomach with great velocity, almoſt as if ſhot from a muſket. This ball the animal chews very accurately, and then ſwallows it again, and ſo on alternately, till all the food ſhe has eaten has undergone this operation. This is eaſily explained from the ſtructure of the œſophagus, which has one ſet of fibres calculated for bringing up the graſs, and another for bringing it down again.

By means of rumination, the cow extracts a much larger proportion of nouriſhment from her food, than thoſe animals which do not ruminate; and hence ſhe is contented with much worſe fare, and ſmaller quantities of it, than a horſe; hence alſo the dung of cows, being much more exhauſted of its fine parts than horſe-dung, proves much inferior to it as a manure.

The *ſpleen* differs not much either in figure or ſituation from that of a dog's; but it is a little more firmly fixed to the diaphragm, there not being here ſo much danger of this viſcus's being hurt in the flexions of the ſpine.

The *liver* it not ſplit into ſo many lobes in this creature as either in a man or dog; which depends on the ſmall motion this creature enjoys in its ſpine, which made ſuch a diviſion needleſs. This alſo confirms what I formerly advanced on this head.

Their *veſica urinaria* is of a pyramidal ſhape. It is very large, and more membranaceous; for the urine of theſe creatures not being ſo acrid as

that

ſhat of carnivorous animals, there was no ſuch occaſion for expelling it ſo ſoon.

The male is provided with a looſe pendulous *ſcrotum*, and conſequently with *veſiculæ ſeminales*. The female organs differ from thoſe of a bitch, moſtly as to the form of the cornua uteri, which are here contorted in form of a ſnail. In this, and all uniparous animals, they contain only part of the ſecundines; but in bitches, and other multiparous animals, they run ſtraight up in the abdomen, and contain the fœtus themſelves.

The ſituation of the *heart* is pretty much the ſame with that of a dog, only its point is rather ſharper: In us, the heart beating continually againſt the ribs, and both ventricles going equally far down to the conſtitution of the apex, it is very obtuſe; but here the apex is made up only of the left ventricle, ſo is more acute.

The *aorta* in this creature is juſtly divided into *aſcending* and *deſcending*, though this diviſion is ill-founded either in a dog or man; and it has certainly been from this ſubject that the older anatomiſts took their deſcriptions when they made this diviſion; for here the aorta divides into two, the aſcending and deſcending.

Of FOWLS in general.

THE next claſs of animals we come to conſider are of the feathered kind; which are divided into the *granivorous* and *carnivorous*. But before we go on to conſider the ſpecialties in the viſcera of each kind, we muſt obſerve what both ſpecies agree in.

Fowls have a particular covering of feathers different from all other creatures, but exactly well ſuited to their manner of life; for it not only protects them from the injuries of the weather, but

but ſerves them in their progreſſion through that thin aerial element they are for the moſt part employed in; and as ſome fowls live much in the water, their feathers being continually beſmeared with an oily liquor, keeps the water from ſoaking into their ſkins, and ſo prevents the bad effects which it would infallibly otherwiſe produce.

Fowls have the ſtrongeſt muſcles of their whole body inſerted into their wings; whence by the way we may obſerve, that it is altogether impoſſible for man to buoy himſelf up into the air like birds, even though he had proper machines in place of wings, unleſs he were likewiſe provided with muſcles ſtrong enough for moving them, which he has not. In the next place, their wings are not placed in the middle of their bodies, but a good deal further forwards; whence it would at firſt view appear, that their heads would be erect, and their poſterior parts moſt depending when raiſed in the air: but by ſtretching out their heads, which act upon the lever of a long neck, they alter their centre of gravity pretty much; and alſo by filling the ſacs or bladders in the inſide of their abdomen with air, and expanding their tail, they come to make the poſterior part of their bodies conſiderably higher; and thus they fly with their bodies nearly in an horizontal ſituation. Hence we find, that if their necks are kept from being ſtretched out, or if you cut away their tails, they become incapable of flying any conſiderable way. The largeneſs of the wings in different fowls varies according to the occaſions of the creature. Thus birds of prey, who muſt fly a conſiderable way to provide their food, have large ſtrong wings; whereas domeſtic birds, who find their nouriſhment almoſt every where, have very ſhort and but ſmall wings. Their tail is of uſe in aſſiſting to raiſe them in the air; though the chief purpoſe of it is to ſerve as a rudder in

guiding

guiding their flight, whilſt they uſe their wings as we do oars in putting forward a boat. The beſt account of this manner of progreſſion of fowls is given by Alfonſus Borellus, in his treatiſe *De Motu Animalium*; and in the *Religious Philoſopher* we have Borelli's doctrine ſtripped pretty much of its mathematical form. The poſterior extremities are ſituated ſo far back, as to make us at firſt think they would be in continual hazard of falling down forwards when they walk: but this is prevented by their holding up their heads and necks, ſo as to make the centre of gravity fall upon the feet; and when they have occaſion for climbing up a ſteep place, they ſtretch out their head and necks forwards, eſpecially if they are ſhort-legged, the better to preſerve properly the balance of the body. Thus we may obſerve a gooſe entering a barn-door, where generally there is an aſcending ſtep, to ſtretch out its neck, which before was raiſed, and incline its body forwards. This is laughed at by the common people, who aſcribe it to a piece of folly in the gooſe, as if afraid of knocking its head againſt the top of the door.

Carnivorous animals are provided with ſtrong crooked claws for the catching their prey: water-fowls uſe them for ſwimming; and, principally for this purpoſe, have a ſtrong firm membrane interpoſed betwixt the toes. There is a beautiful mechaniſm to be obſerved in the toes of fowls, which is of conſiderable uſe to them. For their toes are naturally drawn together, or bended, when the foot is bended: this is owing to the ſhortneſs of the tendons of the toes, which paſs over them, which is analogous to our heel; and that the toes are ſet in the circumference of a circle, as our fingers are: hence, when the foot is bended, the tendons muſt conſequently be much ſtretched; and, ſince they are inſerted into the toes, muſt of neceſſity bend them when the foot is bended;

bended; and when the foot is extended, the flexors of the toes are again relaxed, and they therefore expanded. This is alſo of great uſe to different kinds of fowls: thus the hawk deſcending with his legs and feet extended, ſpreads his talons over his prey; and the weight of his body bending his feet, the toes are contracted, and the prey is ſeized by the talons. This is alſo of great uſe to water-fowls: for had there been no ſuch contrivance as this, they muſt have loſt as much time when they pulled their legs in as they had gained by the former ſtroke; but, as the parts are now framed, whenever the creature draws in its foot, the toes are at the ſame time bended and contracted into leſs ſpace, ſo that the reſiſtance made againſt the water is not near ſo great as before: on the contrary, when they ſtretch their foot, their toes are extended, the membrane betwixt them expanded, and conſequently a greater reſiſtance made to the water. Again, ſuch fowls as live moſtly in the air, or have occaſion to ſuſtain themſelves on branches of trees in windy weather, and even in the night-time when aſleep, while all their muſcles are ſuppoſed to be in a ſtate of relaxation; ſuch, I ſay, have no more to do but lean down the weight of their bodies, and their toes continue bended without any muſcles being in action; and whenever they would diſentangle themſelves, they raiſe up their bodies, by which their foot, and conſequently their toes are extended.

The roſtrum, bill, or beak of fowls, is compoſed of 2 mandibulæ, and, as in quadrupeds, the upper one has no motion but what it poſſeſſes in common with the head. But parrots are an exception to this rule; for they can move the upper mandible at pleaſure: this is exceeding convenient, as it enables them to lay hold of whatever comes in their way. Carnivorous fowls have their beaks long, ſharp,

ſharp, and crooked; the domeſtick fowls, ſuch as the hen kind, &c. have ſtrong ſhort beaks, commodiouſly fitted to dig up and break their food; the water-fowls, again, have long or very broad ſcoop-like beaks, which is moſt convenient for them. The *ſternum* of fowls is much larger proportionally than the human, and has a ridge riſing in its middle for the more commodious origin of the muſcles that move the wings. It is alſo leſs moveable than ours; for had it been very moveable, a great deal of the force employed for moving the wings would at every contraction of the muſcles have been loſt, or elſe ſome other muſcles muſt have come in play to keep firm the ſternum; but this aditional weight would have been inconvenient for their progreſſion.

What other things are moſt remarkable in the ſtructure of the ſeveral viſcera, we ſhall conſider in that common domeſtic animal the cock or hen, and afterwards obſerve the difference of their *viſcera chylopoietica* from a carnivorous fowl.

The ANATOMY of a COCK.

THOUGH this kind of birds live upon food ſomewhat ſimilar to that of man, yet as they have no teeth to ſeparate or break down this food, we would expect to find ſomething to compenſate for the want of teeth, ſomething remarkable in the organs of digeſtion: we ſhall therefore begin with theſe parts.

The *œſophagus* of this creature runs down its neck, ſomewhat inclined to the right ſide; and terminates in a pretty large membranous ſac, which is the ingluvies or crop, where the food is macerated and diſſolved by a liquor ſeparated by the glands, which are eaſily obſerved every-where on the external ſurface of this bag. The effect of this

this maceration may be very well obſerved in pigeons, who are ſometimes in danger of being ſuffocated by the peaſe, &c. they feed upon, ſwelling to ſuch an immenſe bulk in their ingluvies, that they can neither get upwards nor downwards. If it be a favourite fowl, it might be preſerved by opening the ſac, taking out the peaſe, and ſewing up the wound.

The food getting out of this ſac, goes down by the remaining part of the œſophagus into the *ventriculus ſuccenturiatus*, or *infundibulum Peyeri*, which is a continuation of the gullet with more numerous glands, which ſeparate a liquor to dilute the food ſtill more, which at length get into the true ſtomach or gizzard, *ventriculus calloſus*, which conſiſts of two very ſtrong muſcles covered externally with a tendinous aponeuroſis, and lined on the inſide by a very thick firm membrane, which we evidently diſcover to be a production of the cuticula. This might have been proved in ſome meaſure *à priori*, from taking notice, that this membrane, which in chicks is only a thin ſlight pellicle, by degrees turns thicker and ſtronger the more attrition it ſuffers: but there is no other animal-ſubſtance, ſo far as we know, which grows more hard and thick by being ſubjected to attrition, excepting the cuticula. Hence may be drawn ſome kind of proof of what I have ſometimes affirmed concerning the tunica villoſa of the ſtomach and inteſtines in the human body, viz. that it was in part a continuation of the epidermis; nay, all the hollow parts of the body, even arteries, veins, &c. ſeem to be lined with a production of this membrane, or one analagous to it. The uſe of the internal coat of the ſtomach of fowls is to defend the more tender parts of that viſcus from the hard grains and little ſtones thoſe creatures take down. The uſe of the gizzard is to compenſate for the want of teeth; and it is

well

well fitted for this purpoſe from the great ſtrength it poſſeſſes.

The digeſtion of theſe animals is performed merely by attrition, as is evinced by many experiments; and it is further aſſiſted by the hard bodies they ſwallow. We ſee them daily take down conſiderable numbers of the moſt ſolid rugged little flints they find; and theſe can ſerve for no other purpoſe than to help the trituration of their aliments. After theſe pebbles, by becoming ſmooth, are unfit for this office, they are thrown up by the mouth. Hence fowls that are long confined, though ever ſo well fed, turn lean for want of theſe ſtones to help their digeſtion. But this was put beyond all diſpute by Mr Tauvry, who gave a ſpecies of metal to an oſtrich, convex on one ſide and concave on the other, but carved on both; and opening the creature's body ſome time after, it was found, that the carving on the convex ſide was all obliterated, while the engraved character remained the ſame as before on the concave ſide, which was not ſubjected to the ſtomach's preſſure: which could not have happened had digeſtion been performed by a menſtruum, or any other way whatſoever; but may be eaſily ſolved by allowing a ſimple mechanical preſſure to take place. We are, however, by no means to conclude from this, as ſome have too raſhly done, that in the human body digeſtion is performed by ſimple attrition; otherwiſe we may, with equal ſtrength of reaſon, by as good arguments drawn from what is obſerved in fiſhes, prove that the aliments are diſſolved in our ſtomachs by the action of a menſtruum. But this method of reaſoning is very faulty; nor can it ever bring us to the true ſolution of any philoſophical or medical problem. It is very plain, ſince the ſtructure of the parts of the human ſtomach are ſo very different from that of this creature, that it is fooliſh and unreaſonable

to imagine both of them capable of producing the ſame effects. At each end of the ſtomach, there are as it were two particular ſacs of a different texture from the reſt of the ſtomach, not conſiſting of ſtrong muſcular fibres; they ſeem to be receptacles for the ſtones, (eſpecially at the end which is fartheſt from the orifice), while the digeſted aliment is protruded into the inteſtines.

The *duodenum* begins pretty near the ſame place at which the œſophagus enters; yet notwithſtanding the vicinity of theſe two tubes, the aliments are in no danger of getting out before they are perfectly digeſted, by reaſon of a protuberance, or *ſeptum medium*, betwixt the orifices; and in thoſe creatures who have ſuch a ſtrong muſcular ſtomach, it is a matter of great indifference whether the entry of the œſophagus or pylorus be higheſt, provided that the entry from the œſophagus does not allow the food to regurgitate, ſince the force of the ſtomach can eaſily protrude it towards the duodenum. This gut is moſtly in the right ſide, and hangs pendulous in their abdomen, having its two extremities fixed to the liver. The *ductus choledochus* enters near its termination, where it mounts up again to be fixed to the liver; and leſt, by the contraction of the inteſtines, the bile ſhould paſs over without being intimately blended with the chyle, that duct enters downwards, contrary to the courſe of the food, and contrary to what is obſerved in any of the animals we have yet mentioned. But ſtill the general intention is kept in view, in allowing theſe juices the faireſt chance of being intimately blended with the food.

The *ſmall guts* are proportionally larger and much longer than thoſe of carnivorous birds, for the general cauſe already aſſigned. At the end of the ilium they have two large *inteſtina cæca*, one on each ſide, four or five inches long, coming off from the ſide of the rectum, and aſcending; and

we

we find them containing part of the food: These serve as reservoirs to the fæces; which, after some remora, there regurgitate into what soon becomes the rectum; which, together with the excretories of urine and organs of generation, empties itself into the common cloaca. The small intestines are connected by a long loose mesentery, which has little or no fat accompanying the blood-vessels, there being no hazard of the blood's being stopped.

The *pancreas* in the creature lies betwixt the two folds of the duodenum, and sends two or three ducts into this gut pretty near the biliary.

The *spleen* is here of a round globular figure, situated between the liver and stomach; and betwixt these and the back-bone it enjoys the same properties as in other animals, viz. large blood-vessels, &c. All its blood is sent into the *vena portarum*, and has a perpetual conquassation. It has no excretory, as far as we know. Their *liver* is divided into two equal lobes by a pellucid membrane, running according to the length of their body: and hence we may observe, that it is not proper to that bowel to lie on the right side; which is still more confirmed by what we observe in fishes, where it almost lies in the left side.

The shape of their *gall-bladder* is not much different from that of quadrupeds; but is thought to be longer in proportion to the size of the animal, and is farther removed from the liver.

The principal difference to be remarked in their *heart*, is the want of the *valvulæ tricuspides*, and their place being supplied by one fleshy flap.

The *lungs* are not loose within the cavity of the thorax, but fixed to the bone all the way; neither are they divided into lobes, as in those animals that have a large motion in their spine. They are two red spongy bodies, covered with a membrane that is pervious, and which communicates with

the large veſicles or air-bags that are diſperſed over their whole abdomen; which veſicles ſerve two very conſiderable uſes. The one is to render their bodies ſpecifically light, when they have a mind to aſcend and buoy themſelves up when flying, by diſtending their lungs with air, and alſo ſtraiten their *trachea arteria*, and ſo return the air. Secondly, they ſupply the place of a muſcular *diaphragm* and ſtrong abdominal muſcles; producing the ſame effects on the ſeveral contained viſcera, as theſe muſcles would have done, without the inconveniency of their additional weight; and conducing as much to the excluſion of the egg and fæces.

When we examine the upper end of the *trachea*, we obſerve a *rima glottidis* with muſcular ſides, which may act in preventing the food or drink from paſſing into the lungs; for there is no *epiglottis* as in man and quadrupeds.

The *trachea arteria*, near where it divides, is very much contracted; and their voice is principally owing to this coarctation. If you liſten attentively to a cock crowing, you will be ſenſible that the noiſe does not proceed from the throat, but deeper; nay, this very pipe, when taken out of the body and cut off a little after its diviſion, and blown into, will make a ſqueaking noiſe, ſomething like the voice of theſe creatures. On each ſide, a little higher than this contraction, there is a muſcle ariſing from their ſternum, which dilates the trachea. The cartilages, of which the pipe is compoſed in this animal, go quite round it; whereas in men and quadrupeds they are diſcontinued for about one-fourth on the back-part, and the intermediate ſpace is filled up by a membrane. Neither is the trachea ſo firmly attached to their vertebræ as in the other creatures we have examined. This ſtructure we ſhall find of great

ſervice

ſervice to them, if we conſider, that, had the ſame ſtructure obtained in them as in us, their breath would have been in hazard of being ſtopped at every flexion or twiſting of their neck, which they are frequently obliged to. This we may be ſenſible of by bending our necks conſiderably on one ſide, upon which we ſhall find a great ſtraitneſs and difficulty of breathing; whereas their trachea is better fitted for following the flexions of the neck by its looſe connection to the vertebræ.

In place of a *muſcular diaphragm*, this creature has nothing but a thin membrane connected to the pericardium, which ſeparates the thorax and abdomen. But beſides this, the whole abdomen and thorax are divided by a longitudinal membrane or *mediaſtinum* connected to the lungs, pericardium, liver, ſtomach, and to the fat lying over their ſtomach and guts, which is analagous to an *omentum*, and ſupplies its place.

The *lymphatic ſyſtem* in birds conſiſts, as in man, of lacteal and lymphatic veſſels, with the thoracic duct.

The lacteals indeed, in the ſtricteſt ſenſe, are the lymphatics of the inteſtines; and, like the other lymphatics, carry only a tranſparent lymph; and inſtead of one thoracic duct, there are two, which go to the jugular veins. In theſe circumſtances, it would ſeem that birds differ from the human ſubject, ſo far at leaſt as we may judge from the diſſection of a *gooſe*, the common ſubject of this inquiry, and from which the following deſcription is taken.

The lacteals run from the inteſtines upon the meſenteric veſſels: thoſe of the duodenum paſs by the ſide of the pancreas; afterward they get upon the cæliac artery, of which the ſuperior meſenteric is a branch. Here they are joined by the lymphatics of the liver, and then they form a plexus which ſurrounds the cæliac artery. Here

alſo they receive a lymphatic from the gizzard, and ſoon after another from the lower part of the œſophagus. At the root of the cæliac artery they are joined by the lymphatics from the glandulæ renales, and near the ſame part by the lacteals from the other ſmall inteſtines, which veſſels accompany the lower meſenteric artery; but, before they join thoſe from the duodenum, receive from the rectum a lymphatic, which runs from the blood-veſſels of that gut. Into this lymphatic ſome ſmall veſſels from the kidneys ſeem to enter at the root of the cæliac artery. The lymphatics of the lower extremities probably join thoſe from the inteſtines. At the root of the cæliac artery and contiguous part of the aorta, a net-work is formed by the veſſels above deſcribed. From this net-work ariſe two thoracic ducts, of which one lies on each ſide of the ſpine, and runs obliquely over the lungs to the jugular vein, into the inſide of which it terminates, nearly oppoſite to the angle formed by the vein and this ſubclavian one. The thoracic duct of the left ſide is joined by a large lymphatic, which runs upon the œſophagus. The thoracic ducts are joined by the lymphatics of the neck, and probably by thoſe of the wings where they open into the jugular veins. The lymphatics of the neck generally conſiſt of two large branches, on each ſide of the neck, accompanying the blood-veſſels; and theſe two branches join near the lower part of the neck, and form a trunk which runs cloſe to the jugular vein, and opens into a lymphatic gland; from the oppoſite of this gland a lymphatic comes out, which ends in the jugular vein.

On the left ſide, the whole of this lymphatic joins the thoracic duct of the ſame ſide: but, on the right one, part of it goes into the inſide of the jugular vein a little above the angle; whilſt another

ther joins the thoracic duct, and with that duct forms a common trunk, which opens into the inside of the jugular vein, a little below the angle which that vein makes with the subclavian. This system in birds differs most from that of quadrupeds, in the chyle being transparent and colourless, and in there being no visible lymphatic glands, neither in the course of the lacteals, nor in that of the lymphatics of the abdomen, nor near the thoracic ducts.

The *kidneys* lie in the hollow excavated in the side of the back-bone, from which there is sent out a bluish-coloured canal running along by the side of the *vas deferens*, and terminating directly into the common cloaca. This is the *ureter*, which opens by a peculiar aperture of its own, and not at the penis. Fowls having no *vesica urinaria*, it was thought by some they never passed any urine, but that it went to the nourishment of the feathers: but this is false; for that whitish substance that you see their greenish fæces covered with, and which turns afterwards chalky, is their urine. Let us next consider the organs of generation of both sexes, and first those of the male.

The *testicles* are situated one on each side of the back-bone; and are proportionally very large to the creature's bulk. From these run out the *vasa seminifera*; at first straight; but after they recede farther from the body of the testicle, they acquire an undulated or convoluted form, as the epididymis in man. These convolutions partly supply the want of *vesiculæ seminales*, their coition being at the same time very short: These terminate in the penis, of which the cock has two, one on each side of the common cloaca, pointing directly outwards. They open at a distance from each other, and are very small and short; whence they have escaped the notice of anatomists, who have often denied their existence. In birds there

is no proſtate gland. This is what is chiefly remarkable in the organs of the male.

The *racemus vitellorum*, being analagous to the ovaria in the human ſubject, are attached by a proper membrane to the back-bone. This is very fine and thin, and continued down to the uterus. Its orifice is averſe with reſpect to the ovaria; yet notwithſtanding, by the force of the *orgaſmus venereus*, it turns round and graſps the *vitellus*, which in its paſſage through this duct, called the *infundibulum*, receives a thick gelatinous liquor, ſecreted by certain glands. This, with what it receives in the uterus, compoſes the white of the egg. By this tube then it is carried into the uterus. The ſhell is lined with a membrane; and in the large end there is a bag full of air, from which there is no outlet.

The *uterus* is a large bag, placed at the end of the *infundibulum*, full of wrinkles on its inſide; here the egg is completed, receiving its laſt involucrum, and is at laſt puſhed out at an opening on the ſide of the common cloaca. From the teſtes in the male being ſo very large in proportion to the body of the creature, there muſt neceſſarily be a great quantity of ſemen ſecerned; hence the animal is ſalacious, and becomes capable of impregnating many females. The want of the *veſiculæ ſeminales* is in ſome meaſure ſupplied by the convolutions of the *vaſa deferentia*, and by the ſmall diſtance betwixt the ſecerning and excretory organs. The two *penes* contribute alſo very much to their ſhort coition; at which time the opening of the uterus into the cloaca is very much dilated, that the effect of the ſemen on the vitelli may be the greater.

A hen will of herſelf indeed lay eggs; but theſe are not impregnated, and yet appear entirely complete.

I come now to conſider the nutrition of the fœtuſes of oviparous animals, and ſhall give a ſhort hiſtory of an egg, and of the changes brought on it by incubation. To ſave the perpetual repetition of my being aſſured of the truth of each fact by repeated obſervations, I have to obſerve once for all, that unleſs where I expreſsly confeſs I had no opportunity, or neglected to examine them, I conſider myſelf obliged to give ocular demonſtration of what I aſſert.

1. The ſhell of an egg becomes more brittle by being expoſed to a dry heat.

2. The ſhell is lined every-where with a very thin, but pretty tough, membrane; which, dividing at or very near to the obtuſe end of the egg, forms a ſmall bag, where only air is contained.

3. In a new-laid egg, this folliculus appears very little, but becomes larger when the egg is kept.

4. The albumen, or white of an egg, is contained in concentrical membranes, but is not all of the ſame conſiſtence: for the exterior part of it is thin, and diffuſes itſelf almoſt like water when the membranes are broken; whereas its anterior part is more viſcous.

5. The white of an egg can make its way thro' the ſhell, as appears from its waſting by keeping, eſpecially if it is expoſed to gentle heat.

6. The globular vitellus or yolk would ſeem to be no other than a liquor incloſed in a membrane; becauſe, whenever the membrane is broke, it runs all out; and it is ſpecifically heavier than the white.

7. The chalazæ are two white ſpongy bodies, riſing very ſmall from oppoſite ſides of the membrane of the yolk, but gradually become larger as they are ſtretched out from it in an oblique direction with regard to the two ends of the egg.

8. If we compare the chalazæ to the extremi-

ties

ties of an axis paſſing through the ſpherical vitellus, this ſphere will be compoſed of two equal portions, its axis not paſſing through its centre; conſequently, ſince it is heavier than the white, its ſmaller portion muſt always be uppermoſt in all poſitions of the egg.

9. The yellowiſh-white round ſpot, called *cicatricula*, is placed on the middle of the ſmaller portion of the yolk; and therefore muſt (by § 8.) always appear on the ſuperior part of the vitellus.

10. The cicatricula ſeems to be compoſed of ſeveral circles of different colours; and, in a fecundated egg, contains the embryo or chick. See Malpighi *.

11. Eggs, whoſe obtuſe ends are all rubbed over with linſeed-oil, or ſuch other ſubſtances as block up ſmall pores, are as fit for bringing forth chickens, when incubated by a hen, as other eggs are.

I did not make the experiment; but can give a voucher, whoſe ſcrupulous candour, with ſincere good wiſhes and endeavours for the improvement of phyſic in this place, numbers muſt be acquainted with: I mean my father; who beſmeared eighteen eggs in the manner mentioned; then having put a mark on them, he ſet them, with the like number of other eggs, under three hens, who brought out thirty-ſix chickens, not one egg of the whole number failing.

12. After incubation, the *folliculus aëris* is gradually extended; till, near the time of the excluſion of the chick, it occupies, as near as I could judge, ſome more than a third of the cavity of the ſhell.

13. The extended folliculus does not collapſe, upon being expoſed to the preſſure of the atmoſphere after incubated eggs are opened †.

14. By

* De Ovo Incubat.

† It is ſomewhat out of my ſphere to inquire how this additional air gets into the folliculus: but if any are curious enough to make this

14. By incubation the albumen becomes thinner and more turbid, eſpecially on its upper part near to the air-bag, where it is alſo firſt conſumed: and it is afterwards diminiſhed towards the ſharp end of the egg, till at laſt nothing of it is left except a white cretaceous ſubſtance at the lower part of the ſhell.

15. As the part of the white neareſt to the cicatricula is waſted, its membrane and the cicatricula ſtill approach nearer, till they become contiguous. This membrane of the albumen is what is commonly called the *chorion*.

16. Some time before the albumen is quite conſumed, what remains of it is placed at the lower part of the egg; and therefore the yolk is interpoſed betwixt it and the membrane which immediately contains the fœtus. See § 9. and 10.

17. The white of a fecundated egg is as ſweet and free from corruption, during all the time of incubation, as it is in a new-laid egg.

I taſted, ſmelled, and ſwallowed the whites of eggs during all the ſtates of incubation, both when they were raw and boiled, and conſtantly found it as juſt now deſcribed; and therefore cannot imagine how Bellini * could affirm it to have a heavy, abominably ungrateful taſte, a ſtinking ſmell, and not only to occaſion, when ſwallowed, a troubleſome ſenſation in the ſtomach and guts, but to prove purgative. He muſt unluckily have examined none but ſubventaneous eggs: which is further confirmed by his deſcription of the ſmall particles in the colliquated albumen, that reflect light

this inquiry, I would recommend to them to obſerve how this folliculus diſtends and keeps ſtretched in an exhauſted receiver of an air-pump; to exhauſt the air gradually out of the ſhell, while it ſtands expoſed to the atmoſphere, both while the folliculus is entire, and after it is broke, obſerving always the riſing or falling of the mercurial gage; to conſider § 11. and 13.; and to conſult Bellini *de mot. cord.* prop. ix. and Hale's Staticks.

* De Motu Cord. prop. vi.

light ſo ſtrongly as the eye cannot bear it; which I ſaw in ſome ſubventaneous eggs, but could not obſerve in any that were impregnated.

18. According to Bellini *, the colliquated white always becomes incapable of coagulation by heat; but in the trials I made, it frequently did coagulate, though I found the ſucceſs of this experiment very uncertain: the only general rule I could fix was, that, before the 9th or 10th day of incubation, the thinner white did not generally coagulate; but after that, it frequently did.

19. Very ſoon after incubation, the volume of the yolk appears increaſed; and, by its riſing then nearer to the upper part of the egg, one may conclude that its ſpecific weight decreaſes.

20. The yolk becomes pale and more fluid for ſome time, eſpecially on the ſide next to the chick, where its bulk alſo ſooneſt increaſes; but afterwards the membranes of the yolk turn firmer and ſtronger, and the liquor in them is leſs in quantity, and becomes more viſcous.

21. As the chick increaſes, the yolk is depreſſed in the middle; and is ſoon brought into a form ſomething like to a horſe-ſhoe, in the middle of which the chick is lodged.

22. The yolk remains freſh and uncorrupted all the time of incubation, and is always coagulable.

23. Not long before the excluſion of the chick, the whole yolk is taken into its abdomen.

24. The whole albumen and vitellus are not conſumed by the chick: for ſome part of the humours of the egg eſcapes through the ſhell, and is not ſupplied by any thing from without; as evidently appears by an egg's becoming ſo much ſpecifically lighter, as to ſwim in water after incubation, though it ſunk in it when recent.

25. The chalazæ remain long without being con-

* De Motu Cord. prop. vi.

conſiderably changed, unleſs that they are brought nearer to each other by the creſcent form of the yolk; at laſt they degenerate into a dry chalky ſubſtance.

26. The cicatricula very ſoon is enlarged by incubation; and, being buoyed up on the top of the yolk to the ſuperior part of the egg, it is placed very near to the air-bag; and when both increaſe, they become contiguous.

27. The cicatricula is called *amnios*, when it becomes large, and contains the colliquamentum or liquor in which the chick is immerſed.

28. The quantity of the colliquamentum gradually increaſes till the 15th or 16th day of incubation; on the 18th, it is all conſumed; and, in the three following days, ſcarce any moiſture can be obſerved on the internal ſurface of the amnios.

29. The liquor of the amnios is more clear and tranſparent than the colliquated white; its taſte is more ſalt, and it has no obſervable ſmell. Its conſiſtence is at firſt a little viſcous, then it becomes more fluid, and afterwards turns a little ropy again.

N. I can ſay nothing of the particular times when it does or does not coagulate by heat: for it is in ſo ſmall quantity during the greater part of the time of incubation, that one can ſcarce gather as much in a ſpoon as is fit to make any experiment with; and when all the egg is boiled hard, it adheres ſo cloſely to the white, that it is ſcarce poſſible to diſtinguiſh one from the other. Malpighius *, ſpeaking of the egg between the 14th and 19th day, ſays, "That this thin diaphanous liquor of the amnios was ſometimes forced, by boiling, into a white taſty ſubſtance;" which my trials alſo confirmed.

30. The allantois and its contained urine are to

* De Ovo Incubato.

be ſeen in an egg, as well as in the ſecundines of viviparous animals *.

31. Though the heart is among the firſt parts of the chick that can be diſtinguiſhed, yet the umbilical veſſels are ſeen much about the ſame time that the heart is obſerved.

I did not inquire into this fact; but have two very good vouchers for its truth, Harvey † and Malpighius ‡.

32. The umbilical veſſels gradually diſperſe their branches upon the amnios, upon the vitellus, and upon the membranes of the albumen: The extremities of the much greater number, being immerſed into the white, are extended proportionally as it is colliquated.

33. Near to the end of incubation, the umbilical veſſels begin to ſhrivel and decreaſe, till at the excluſion they are very ſmall.

34. The embryo is ſeen in an egg at firſt in form of a ſmall worm: then its carina or ſpine, with the large prominences, that afterwards ſhew themſelves to be the brains and eyes, appear; the other bowels ſeem hanging from the ſpine; the chaſm of the mouth diſcovers itſelf; the extremities ſprout out; the viſcera are gradually covered with the tegûments; and at laſt the beak, nails, and feathers are ſeen: after which all the parts become ſtronger and firmer, the proportional bulk of the head decreaſing.

For the particular times when all theſe changes are thus orderly brought about, conſult Fabric. ab Aquapendente, Harvey, and Malpighius.

35. After all the parts of the chick are formed, it is always found lying on its ſide, with its neck greatly bended forward, the head being covered with the upper wing, and the beak placed between the thighs.

36. When

* Malpig. Append. de Ovo Incub. tab. vii.
† De Generat. Animal. exercit. 16. and 17.
‡ De Ovo Incubato.

36. When the ſhell is opened after the chick is large and ſtrong, it may be ſeen to bounce and ſpurn, ſometimes opening its mouth wide, eſpecially if it is ſtirred or pricked.

37. The mouth, œſophagus, and ingluvies, are always found moiſt; but never contain any quantity of liquor that can be collected or will run out in drops.

38. The bulbous glandular part of the œſophagus immediately above the ſtomach, or what Peyer * calls the *infundibulum*, and the ſtomach, are full of a liquor, in the youngeſt chick we can diſſect, and continue full the whole time of incubation; neither infundibulum nor ſtomach having yet got the tendinous firmneſs they have in adults; nor can we obſerve the dry pellicle which is ſo eaſily ſeparated from theſe parts in hens.

39. This liquor of the ſtomach is at firſt thin and more watery; afterwards it becomes curdy; and at laſt is all in form of a greyiſh white mucus, unleſs that ſome part of it frequently is coloured yellow or green by a mixture of bile. It always coagulates, by boiling, into a firm yellowiſh white ſubſtance.

40. The quantity of fæces was not large in the great guts of any chickens I opened before excluſion.

41. A little time before the excluſion, the chick may frequently be heard making the ſame piping ſound that hatched chickens make. In three eggs, which were all I opened in this ſtate, the beak of the chick had perforated the membrane of the *folliculus aëris*.

42. The ſhell at the obtuſe end of the egg frequently appears cracked ſome time before the excluſion of the chick.

43. The chick is ſometimes obſerved to perforate the ſhell with its beak; but, in thoſe I ſaw

* Comment. in Anat. Ventricul. Gallin.

tumbling out of the ſhell, it was broke off irregularly, at the place where the membrane of the *folliculus aëris* was joined to it.

44. After the excluſion of the yolk is gradually waſted, being conveyed into the ſmall guts by a ſmall duct, its membranes gradually contract themſelves, and the duct becomes ſhorter. On the tenth day after excluſion, the vitellus was no larger than a ſmall pin-head, and the duct was ſcarce one-twentieth part of an inch long.

From this hiſtory of the egg and of incubation, I ſhall endeavour to deduce the manner in which the colliquated white is taken in by the chick.

Authors generally ſeem to agree, that the oviparous fœtus, while very young, receives its nouriſhment by the navel; but ſeveral of the beſt reputation have been of opinion, that afterwards it is conveyed by the mouth. I ſhall examine the arguments they uſed in proof of this, and then ſhall ſubjoin ſome negative reaſons which they have not taken notice of.

Bellini * has deſcribed the cicatricula, or *faccu-lus amnii*, with the chalazæ firſt formed in the back of the hen; to which, according to him, the vitellus is afterwards joined, and the white is acquired as they tumble down the oviduct. He ſays the chalazæ are compoſed of numerous canals, which open into the amnios, and ſend out their roots into the cavity of the yolk, and into the white. It is eaſy to conceive what conſequences may be drawn from this deſcription, by thoſe who aſſert the nouriſhment to be carried by the mouth, viz. That here are direct paſſages into the cavity where the chick is, which can take up the liquors no other way than by the mouth.

The anſwer to this obſervation is the ſame as has been made to the other facts already quoted from

* De Mot. Cord. prop. ix.

from this author. I deny that the *ſacculus amnii* is formed before the vitellus; on the contrary, the vitellus is evidently to be ſeen before the cicatricula or chalazæ can be diſcerned. Next, I deny the chalazæ (if they are canals) to have the leaſt communication with the amnios, at any time, or in any ſtate of the egg, otherwiſe than as they are both adhering to the membrane of the vitellus, upon which, or within which, no particular fibres, no canals, are ſtretched to the cicatricula. Every one has it in his power to examine theſe facts. If then the facts are denied, the conſequences cannot be admitted.

Since there are no canals paſſing through the yolk, that open into the *ſaccus colliquamenti*, and the cicatricula comes to be placed on the upper part of the yolk, and contiguous to the air-bag (§ 26.), it is evident, that the *liquor amnii* muſt be furniſhed by the chicken, which being covered with feathers, having no mammæ, bladder of urine, or large ſalivary glands, can only ſupply it by the branches of the umbilical veſſels ſpread on the amnios.

Harvey * affirms, that a liquor is found in the mouth and ingluvies of the chick, which he concludes to be the colliquamentum or *liquor amnii*, from their reſemblance; from the quantity of the contents of the ſtomach; from the chick's being ſeen to open its mouth; and from the neceſſity creatures are in of ſwallowing, or of foreing back by vomiting, whatever is introduced to the root of their tongue.

As to the reſemblance, I do not ſee how the compariſon can be made, ſeeing the liquor in the mouth and crop is in ſuch ſmall quantity, (§ 37.) But ſuppoſe that a ſufficient quantity was collected, the two liquors agreeing in ſeveral properties would not of itſelf be a ſufficient proof of their

* De Generat. Animal. exercit. 58.

being the ſame; and if, for argument's ſake, the liquor in the crop was granted to be in very large quantity, and to agree in every property with that in the amnios, it would certainly appear in the ſame form for ſome time in the ſtomach; whereas it is always found very different there in the larger fœtus (§ 39.); and Harvey confeſſes as much in this place: therefore it may be concluded, that it does not go down into the ſtomach.

If ever any thing like fæces has been ſeen in the crop of chickens, as has been alleged by ſome, it might be no more than the yellow or green-coloured ſubſtance brought up from the ſtomach, (§ 39.)

The quantity of the contents of the ſtomach and inteſtines may be accounted for from § 38. applied to what was ſaid on viviparous animals.

Though creatures that reſpire are under a neceſſity of either ſwallowing, or forcing back by vomiting, whatever is introduced beyond their fauces, I cannot think it ſhould be thence concluded that a fœtus is under the ſame neceſſity: for, as it does not exerciſe reſpiration, it will ſuffer no inconvenience by a liquor lodging near to the glottis; whereas creatures that breathe cannot allow any ſubſtance to remain there without danger of the glottis being ſtopped, or of ſuch ſubſtances falling down the trachæa, either of which would be of bad conſequence; which the creature prevents, by forcing ſuch ſubſtances out of ſuch a dangerous ſituation.

But, to enforce the negative of the colliquamentum paſſing by the mouth, obſerve, that there are only three days in which this paſſage can moſt probably be ſuppoſed to happen, which are from the 15th to the 18th day of incubation; for before the 15th, the quantity of the *liquor amnii* is increaſing, which is no great ſign of its being ſwallowed; and after the 18th this liquor is not to be

be ſeen, (*vid.* § 28.) If, then, the *liquor amnii* were all ſwallowed between the 15th and 18th days, the ſtomach ought to be fuller at this time, and its contents ſhould be thinner, more pellucid, &c. like to the colliquamentum; which I am certain does not happen. Beſides, if we ſuppoſe the power of digeſtion ſo ſtrong as to expel this liquor as faſt as it is taken down in theſe three days, it would certainly follow, that this powerful digeſtion continuing in the three ſucceeding days, while there is no liquor to be ſwallowed, the ſtomach ought to be quite emptied; which every one who opens the ſtomachs of chickens at this time will ſee it is not. And, laſtly, as a more direct proof ſtill againſt Harvey, I broke the ſhells of ſeveral incubated eggs, while the colliquamentum was in large quantity; and before the amnios was opened, I ſaw the chickens open their mouths very wide ſeveral times, but could not obſerve the quantity of the liquor in which they lay any way leſſened. I afterwards carefully diſſected the chickens, and found no other than the common ſmall quantity in the crops, and the ordinary curdy mucus in the ſtomach; which ſeems to me a demonſtration that they do not ſwallow.

After ſuch convincing proofs, it will be needleſs to make any application of the arguments in the former part of this eſſay to this ſubject; and therefore I ſhall only deſire the reader to compare the poſture of a chick, and of a hen while ſhe ſwallows liquors, that they may ſee the poſture of the chick's neck to be moſt unfavourable to the ſuppoſition of deglutition being performed; and then ſhall conclude with a very ſhort hiſtory of incubation, aſſigning what I imagine to be the moſt probable reaſons of the ſeveral appearances.

By the heat of the hen, or of ſtoves equal to it, aſſiſted poſſibly by the action of the air contained in the *folliculus aëris* (§ 2. 3. 12.), the albumen becomes

comes thinner, eſpecially where it is moſt expoſed to theſe forces (§ 14.); and the vitellus in the ſame manner becomes ſpecifically lighter (§ 19.), and therefore readily riſes in the white. And as, by being divided into two unequal portions by its axis the chalazæ, it preſents the ſmaller portion to the incubating heat at firſt, (§ 8. 9.); ſo the change in conſequence of incubation being ſooneſt and moſt produced here (§ 20.), and the cicatricula being enlarged at the ſame time, the ſmaller portion of the yolk becomes of the leaſt ſpecifical weight; and therefore is buoyed up to the ſuperior part of the egg; whereby the *folliculus aëris* and membranes of the cicatricula become contiguous when they enlarge (§ 26.), and the vitellus can never be in hazard of compreſſing the tender embryo; and the umbilical veſſels are ſituated ſo as to have their extremities immerſed in the liquors that firſt undergo the proper change, for being imbibed by their orifices, (§ 32.)—The incubation continuing, the white is ſtill more and more colliquated, and the umbilical veſſels are proportionally extended, the veins to abſorb it, and the arteries to throw out any particles that are unfit for the chick till they are farther prepared, but eſpecially to drive forward the liquors in the veins, as was explained in the account of the viviparous animals, (§ 20.) —When the white in the upper part of the egg is exhauſted, its membranes become contiguous to the amnios, (§ 15.); and thereby the membranes involving the fœtus, become ſufficiently ſtrong to reſiſt the motions of the chick, when its eaſe or ſafety prompt it at any time to ſpurn —The powers of incubation above-mentioned, aſſiſted by the pulſation and conquaſſatory motions of the numerous umbilical veſſels ſpread on the yolk (§ 32.), diſſolve that humour more, and render ſome part of it fine enough to be taken up by the ſmall extremities of the umbilical vein, ſome of which penetrate its membrane: by which the liquor at

laſt

laſt becomes thicker (§ 20.); and the membrane, being in part emptied, will more eaſily yield to the weight of the chick; and is preſſed into the form of a horſe-ſhoe (§ 21.), while the net-work of veſſels extended on this membrane renders it ſtronger and firmer.—The *folliculus aëris* not only aſſiſts in colliquating the albumen; but, when the humours of the egg come to occupy a leſs ſpace, by eſcaping through the ſhell (§ 24.), and by being changed into the ſolid ſubſtance of the chick, the folliculus enlarging (§ 12.), keeps the chick and humours ſteady, without danger of being diſordered and broke by the motions of the egg.—— Branches of the umbilical veſſels being diſtributed to the amnios (§ 32.), the arteries will pour out their liquors into its cavity in greater quantity than the veins can take them up, as long as the fœtus is weak; but whenever the fœtus becomes ſtronger, and conſequently the abſorbent power of the veins increaſes, they will take up the fluid of the amnios faſter than the arteries pour it in, and its quantity will be diminiſhed till it is quite exhauſted, (§ 28. and 29.)—This abſorption will go on more ſpeedily in proportion alſo to the umbilical veſſels being leſs diſtended with albumen, whereby there is leſs reſiſtance to the progreſſive motion of the abſorbed liquors; which probably is the reaſon of the colliquamentum being all taken up between the 15th and 18th days.—By the conſtant circulation and renewal of all theſe humours of the egg, they keep freſh and uncorrupted in a fecundated egg, (§ 17. and 22.); but corrupt ſoon in a ſubventaneous one, or in ſuch whoſe fœtus dies in the time of incubation.—Wherever veſſels are not ſufficiently filled, they contract themſelves; and therefore the albumen being exhauſted in the laſt days of incubation, the umbilical veſſels gradually ſhrivel (§ 33.), which prevents the danger of an hæmorrhage when the chick is ſeparated from its membranes.

membranes. But as the white is not ſufficient at this time fully to ſupply the chick, the yolk is taken into its body, (§ 23.); and being there preſſed, it is thrown gradually by the proper duct (§ 23. and 44.) into the guts, to ſupply that defect.——The veſſels and glands which open into the alimentary tube ſeparate at leaſt as much liquor as will moiſten it; and, the ſtomach having no callous ſtrong cruſt on its internal ſurface (§ 38.) will ſeparate more than it can do in the adult; and in the mean time the glands of the infundibulum pour out a liquor that is always thicker as the chick increaſes, till it becomes a very thick white mucus: And therefore the contents of the ſtomach of the fœtus in the egg muſt have the appearance deſcribed (§ 39.), and will be ſlowly paſſing off into the inteſtines.——The ſhell at the obtuſe end of the egg becoming more brittle, by being ſo long expoſed to a dry heat (§ 1.), and the membranes loſing their toughneſs when their moiſture is exhauſted, the chick very eaſily tears them, and breaks off that end of the ſhell, to make its way into the common atmoſphere.——The mother having no juices prepared within her body to give to the chick for food after it is hatched, and its organs for taking in and digeſting aliment being for ſome time too weak to ſupply it ſufficiently with nouriſhment, the vitellus is made to ſupply theſe deficiences, till the chick is ſufficiently confirmed and ſtrong (§ 44.); after which it is no longer the ſubject of my preſent inquiry.

After having obſerved the contents of the abdomen and thorax, we next proceed to examine the parts about the neck and head.

Theſe creatures, as was obſerved of fowls in general, have no teeth. Some, indeed, have an appearance of teeth; but theſe are only ſmall proceſſes or ſerræ riſing out from the mandible, without

without any ſocket, &c. which would have been needleſs, as they ſwallow their food entire. But their *tongue* is made pretty firm, leſt it ſhould be hurt by the ſharp points of the grain they feed on. It is of a triangular figure, and pointed before; and as by their depending poſture their meat is in hazard of falling out of their mouths, to prevent this there are ſeveral ſmall pointed papillæ ſtanding out upon their tongue and palate, with their points inclined backwards, allowing an eaſy paſſage to the food, but hindering it to return.

We have here no *velum palatinum*, *uvula*, or *epiglottis*; and in place of two large holes opening into the noſe, there is only a long narrow rima ſupplied with pretty ſtrong muſcles, and ſuch another ſupplies the place of a glottis. The creature has a power of ſhutting both at pleaſure; and the nature of their food ſeems not only to exempt them from the hazard of its getting into the noſe or trachea, but its ſharp points would hurt an uvula, or epiglottis, if they had any. Hence we ſee with what difficulty they ſwallow dough or other ſort of food that can be eaſily moulded into any form. When we examine the upper end of the trachea, we obſerve a rima glottidis with muſcular ſides, which may act in preventing the food or drink from paſſing into the lungs, for there is no epiglottis as in man and quadrupeds.

Their *cranium* is more cellular and cavernous than ours. By this means their heads are light, yet ſtrong enough to reſiſt external injuries; for the enlarging the diameter of bones contributes to their ſtrength. By this cavernous cranium the organ of ſmelling is ſuppoſed to be conſiderably enlarged; and further, ſinging birds, as is obſerved by Mr Ray and Mr Derham, have this cavernous ſtructure of the brain ſtill more obſervable: and we are told that the cavity of the tym-

tympanum communicates with the cells: but this, I am apt to believe, ſo far as I could find from diſſection, is rather founded on theory than matter of fact. Their brain is covered with the common membranes, but its external ſurface is not formed into ſo many gyræ or convolutions as ours. Its anterior part is quite ſolid, of a cineritious colour, and ſo far has a reſemblance of the *corpora ſtriata* as to give riſe to the olfactory nerves. The whole of it appears to us as imperfect, and we can ſcarce determine whether there be any thing analogous to a third or fourth ventricle: neither the *corpus calloſum*, *fornix*, *nates*, or *teſtes*, &c. can be obſerved here; which parts therefore cannot be imagined as abſolutely neceſſary for the functions of life, ſince we find theſe creatures perform them ſufficiently well. We may perhaps think theſe ſerve a particular uſe in man, who is a rational creature; but then quadrupeds enjoy them in common with men. Theſe protuberances, &c. ſeem rather to depend on the different diſpoſition of the ſeveral parts, being variouſly connected and meeting in different directions in different places, than their being abſolutely neceſſary for any particular uſe; and the uſes that have been aſſigned to different parts of the brain by authors, ſeem to me to have no foundation but in the author's fancy. I have already owned my ignorance of the uſes of the particular parts of the brain, ſo ſhall not pretend to give reaſons for their being different in different animals; but all ſeem to agree in this, that the cerebrum has always hollows and vacuities in it.

Their organ of *ſmelling* is very large, and well provided with nerves; hence they have this ſenſation very acute. Ravens and other birds of prey give a ſure proof of this, by their being able

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to find out their prey, though concealed from their ſight and at a conſiderable diſtance.

Thoſe birds that grope for their food in the waters, mud, &c. have large nerves, which run quite to the end of their bills, by which they find out and diſtinguiſh their food.

The anterior part of their *eyes* (inſtead of having the ſclerotic coat contained, ſo as to make near a ſphere as in us) turns all of a ſudden flat; ſo that here the ſclerotic makes but half a ſphere; and the cornea riſes up afterwards, being a portion of a very ſmall and diſtinct ſphere: ſo that in theſe creatures there is a much greater difference betwixt the ſclerotic and cornua than in us. Hence their eyes do not jut out of their heads, as in man and quadrupeds. As moſt of theſe creatures are continually employed in hedges and thickets, therefore, that their eyes might be ſecured from theſe injuries, as well as from too much light when flying in the face of the ſun, there is a very elegant mechaniſm in their eyes. A membrane riſes from the internal canthus, which at pleaſure, like a curtain, can be made to cover the whole eye; and this by means of a proper muſcle that riſes from the ſclerotic coat, and, paſſing round the optic nerves, runs through the *muſculus oculi attollens* (by which however the optic nerves are not compreſſed) and palpebra, to be inſerted into the edge of this membrane. Whenever this muſcle ceaſes to act, the membrane by its own elaſticity again diſcovers the eye. This covering is neither pellucid nor opaque, both which would have been equally inconvenient; but, being ſomewhat tranſparent, allows as many rays to enter as to make any object juſt viſible, and is ſufficient to direct them in their progreſſion. By means of this membrane it is that the eagle is ſaid to look at the

ſun. Quadrupeds alſo, as we mentioned before, have a ſmall *membrana nictitans*.

Beſides, all fowls have another particularity, the uſe of which I think is not ſo well underſtood; and that is, a pretty long black triangular purſe, riſing from the bottom of their eye juſt at the entry of the optic nerve, and ſtretched out into their vitreous humour, and one would imagine it gave ſome threads to the cryſtalline. To this the French (who, as far as I know, were the firſt who took noice of it in their diſſections before the Royal Academy) gave the name of *bourſe noire*. This may poſſibly ſerve to ſuffocate ſome of the rays of light, that they may ſee objects more diſtinctly without hurting their eyes. It has a connection with the vitreous, and ſeems to be joined alſo to the cryſtalline humours. If we ſuppoſe it to have a power of contraction, (which may be as well allowed as that of the iris), it may ſo alter the poſition of the vitreous and cryſtalline humours, that the rays from any body may not fall perpendicularly upon the cryſtalline; and this ſeems to be neceſſary in them, ſince they cannot change the figure of the anterior part of their eye ſo much as we can do: and as this animal is expoſed often to too great a number of rays of light, ſo they have no tapetum, but have the bottom of their eye wholly black on the retina; and in conſequence of this, fowls ſee very ill in the dark.

They have no external ear; but in place thereof a tuft of very fine feathers covering the *meatus auditorius*, which eaſily allows the rays of ſound to paſs them, and likewiſe prevent duſts or any inſect from getting in. An external ear would have been inconvenient in their paſſing through thickets, and in flying, &c. A liquor is ſeparated in the external part of the ear, or *meatus auditorius*,

rius, to lubricate the paſſage, and further prevent the entrance of any inſects, &c. The *membrana tympani* is convex externally; and no muſcles are fixed to the bones of their ear, which are rather of a cartilaginous conſiſtence: Any tremulous motions impreſſed on the air are communicated in theſe creatures merely by the ſpring and elaſticity of theſe bones; ſo, probably, the membrane is not ſo ſtretched as in the human ear by muſcles. The ſemicircular canals are very diſtinct, and eaſily prepared.

The ANATOMY of a CARNIVOROUS BIRD.

WE come next to the birds of prey, and for an example ſhall take a ſtenhil or ſmall hawk. The principal difference to be obſerved in them, is in their chylopoietic viſcera, which may be accounted for from their different way of life.

Immediately under their clavicles, you will obſerve the œſophagus expanded into their *ingluvies*, which is proportionally leſs than in the granivorous kind, ſince their food does not ſwell ſo much by maceration; and for the ſame reaſon, there is a leſs quantity of a menſtruum to be found here.

They have alſo a *ventriculus ſuccenturiatus*, plentifully ſtored with glands, ſituated immediately above their ſtomach, which we ſee here is thin and muſculo-membranous, otherwiſe than in the granivorous kind; and this difference, which is almoſt the only one we ſhall find betwixt the two different ſpecies of fowls, is eaſily accounted for from the nature of their food, which requires leſs attrition, being eaſier of digeſtion than that

of the other kind; nevertheleſs, it ſeems requiſite it ſhould be ſtronger than the human, to compenſate the want of abdominal muſcles, which are here very thin.

The ſame mechaniſm obtains in this creature's *duodenum*, that we have hitherto obſerved. As being a carnivorous animal, its guts are proportionally ſhorter than thoſe of the granivorous kind; for the reaſon firſt given, *viz.* its food being more liable to corrupt, therefore not proper to be long detained in the body; and for that reaſon it has no *inteſtina cæca*, of which the other ſpecies of fowls have a pair. The difference in their wings, backs, and claws, are obvious; and have been already in ſome meaſure obſerved.

The ANATOMY of AQUEOUS ANIMALS.

I. AMPHIBIOUS.

AQUEOUS animals are generally divided into ſuch as have lungs, and ſuch as want them. The firſt ſpecies differ ſo inconſiderably from an ox or any other quadruped, that a few obſervations may be ſufficient to give an idea of their internal ſtructure; for this purpoſe, we ſhall firſt examine that ſpecies of them which moſt reſembles man in the internal ſtructure, the tortoiſe.

TORTOISE. The covering of this animal is compoſed of a ſhell ſo remarkably hard and firm in its texture, that a loaded waggon may go over it, without hurting the ſhell or the animal within it. In the young animal, this ſhell grows harder in proportion as its contents expand; and this creature never changes its ſhell as ſome others do: hence it was neceſſary for it to be made up of different pieces; and theſe are more or leſs diſtinct

in

in different animals. Their feet are ſmall and weak; and they are exceedingly ſlow in motion.

It has neither tongue nor teeth; to make up for which, their lips are ſo hard as to be able to break almoſt the hardeſt bodies.

The alimentary canal very much reſembles that of the former claſs.

The principal difference is in the circulation of the blood. The heart has two diſtinct auricles, without any communication; and under theſe, there is the appearance of two ventricles ſimilar in ſhape to thoſe of the former claſs: but they may be conſidered as one cavity; for, the ventricle ſends out not only the pulmonary artery, but likewiſe the aorta; for there is a paſſage in the ſeptum, by which the ventricles communicate freely, and the blood paſſes from the left into the right one. From the aorta the blood returns into the right auricle, while that from the pulmonary artery returns to the left auricle, from which it is ſent to the left ventricle, &c. ſo that only a part of the blood is ſent through to the lungs, the reſt going immediately into the aorta; hence the animal is not under the neceſſity of breathing ſo often as otherwiſe it would be.

Blood-veſſels. From the baſe of the right ventricle goes out the pulmonary artery and aortæ. The pulmonary artery is ſpent upon the lungs. The aortæ may be ſaid to be three in number; for the aorta ſiniſtra aſcends through the pericardium in company with the pulmonary artery; and afterwards turns down, and ſends off a conſiderable branch, which ſplits into two, one of which joins the right aorta, while the other is diſtributed upon the liver, ſtomach, inteſtines, &c. What remains of this aorta runs to the kidneys or poſterior extremities of that ſide. An aorta deſcendens, &c. after piercing the pericardium, runs down and communicates with the branch already men-

mentioned, is diſtributed upon the right kidney and inferior extremity, and alſo upon the bladder and parts of generation. An aorta aſcendens, after getting out of the pericardium, ſupplies the fore-legs, neck, and head. The blood in the ſuperior part of the body returns to the right auricle by two jugular veins, which unite after perforating the pericardium. From the inferior part, it returns to the ſame auricle by two large veins: one on the right ſide receives the blood in the right lobe of the liver; the other on the left-ſide receives the blood in the left lobe, and alſo a trunk which correſponds with the inferior vena cava in other animals. The pulmonary veſſels run in the left auricle in the common way.

Absorbents. The abſorbent ſyſtem in the turtle, like that in the former claſs, conſiſts of lacteals and lymphatics, with their common trunks the thoracic ducts; but differs from it in having no obvious lymphatic glands on any part of its body, nor plexus formed at the termination in the red veins.

The *lacteals* accompany the blood-veſſels upon the meſentery, and form frequent net-works acroſs theſe veſſels: near the root of the meſentery a plexus is formed, which communicates with the lymphatics coming from the kidneys and parts near the anus. At the root of the meſentery on the left ſide of the ſpine, the lymphatics of the ſpleen join the lacteals; and immediately above this a plexus is formed, which lies upon the right aorta. From this plexus a large branch ariſes, which paſſes behind the right aorta to the left ſide, and gets before the left aorta, where it aſſiſts in forming a very large receptaculum, which lies upon that artery.

From this receptaculum ariſe the thoracic ducts. From its right ſide goes one trunk, which is joined by that large branch that came from the

plexus

plexus to the left ſide of the right aorta, and then paſſes over the ſpine. This trunk is the thoracic duct of the right ſide: for having got to the right ſide of the ſpine, it runs upwards, on the inſide of the right aorta, towards the right ſubclavian vein; and when it has advanced a little above the lungs, it divides into branches, which near the ſame place are joined by a large branch, that comes up on the outſide of the aorta. From this part upwards, thoſe veſſels divide and ſubdivide, and are afterwards joined by the lymphatics of the neck, which likewiſe form branches before they join thoſe from below. So that between the thoracic duct and the lymphatics of the ſame ſide of the neck, a very intricate net-work is formed; from which a branch goes into the angle between the jugular vein and the lower part or trunk of the ſubclavian. This branch lies therefore on the inſide of the jugular vein, whilſt another gets to the outſide of it, and ſeems to terminate in it, a little above the angle, between that vein and the ſubclavian.

Into the above-mentioned receptaculum the lymphatics of the ſtomach and duodenum likewiſe enter. Thoſe of the duodenum run by the ſide of the pancreas, and probably receive its lymphatics and a part of thoſe of the liver. The lymphatics of the ſtomach and duodenum, have very numerous anaſtomoſes, and form a beautiful net-work on the artery, which they accompany. From this receptaculum likewiſe (beſides the trunk already mentioned, which goes to the right ſide) ariſe two other trunks pretty equal in ſize; one of which runs upon the left ſide, and the other upon the right ſide of the left aorta, till they come within two or three inches of the left ſubclavian vein; where they join behind the aorta, and form a number of branches which are afterwards joined by the lymphatics of the left ſide of the neck; ſo that here a

plexus

plexus is formed as upon the right ſide. From this plexus a branch iſſues, which opens into the angle between the jugular and ſubclavian vein.

SERPENT AND CROCODILE. The circulation in theſe is ſimilar to that of the turtle; but we find only one ventricle. The blood goes from the right auricle to the ventricle which ſends out the pulmonary artery and aorta; the blood from the pulmonary artery returns to the left auricle, that from the aorta going to the right auricle, and both the auricles opening into the ventricle.

FROG AND LIZZARD. Theſe differ from the former animals, in having only one auricle and a ventricle: and beſides, the ventricle ſends out a ſingle artery, which afterwards ſplits into two parts; one to ſupply the lungs, the other runs to all the reſt of the body: from the lungs and from the other parts, the blood returns into the auricle.

II. FISHES.

Of theſe we may firſt obſerve, that they have a very ſtrong thick *cuticle*, covered with a great number of ſcales, laid one on another like the tiles of houſes. This among other arguments is ſuppoſed to prove the human epidermis to be of a ſquamous ſtructure: but the ſcales reſemble the hairs, wool, feathers, &c. of the creatures that live in air; and below theſe we obſerve their proper *cuticula* and *cutis*.

The generality of fiſhes, particularly thoſe ſhaped like the cod, haddock, &c. have a line running on each ſide. Theſe lines open externally by a number of ducts, which throw out a mucous or ſlimy ſubſtance that keeps them ſoft and clammy, and ſeems to ſerve the ſame purpoſe with the mucous glands or ducts which are placed within many of our internal organs.

In the next place, theſe creatures have neither

anterior

anterior nor posterior extremities, as quadrupeds and fowls; for their progression is performed in a different way from either of those species of animals: for this purpose they are provided with machines, properly consisting of a great number of elastic beams, connected to one another by firm membranes, and with a tail of the same texture; their spine is very moveable towards the posterior part, and the strongest muscles of their bodies are inserted there. Their tails are so framed as to contract to a narrow space when drawn together to either side, and to expand again when drawn to a straight line with their bodies; so, by the assistance of this broad tail, and the fins on their sides, they make their progression much in the same way as a boat with oars on its sides and rudder at its stern. The perpendicular fins situated on the superior part of their body keep them *in æquilibrio*, hindering the belly from turning uppermost: which it would readily do, because of the air-bag in in the abdomen rendering their belly specifically lighter than their back; but by the resistance these fins meet with when inclined to either side, they are kept with their backs always uppermost.

The best account of this matter, we have in the treatise before-mentioned, viz. *Borelli de Motum Animalium, cap.* 23.

It may be next observed, that these creatures have nothing that can be called a *neck*, seeing they seek their food in an horizontal way, and can move their bodies either upwards or downwards, as they have occasion, by the contraction or dilatation of the air-bag; a long neck, as it would hinder their progression, would be very disadvantageous in the element they live in.

The *abdomen* is covered on the inferior part with a black-coloured thin membrane resembling our peritoneum.

peritoneum. It is divided from the thorax by a thin membranous partition, which has no muſcular appearance; ſo that we have now ſeen two different ſorts of animals that have no muſcular diaphragm.

Theſe creatures are not provided with *teeth* proper for breaking their aliment into ſmall morſels, as the food they uſe is generally ſmall fiſhes, or other animals that need no trituration in the mouth, but ſpontaneouſly and gradually diſſolve into a liquid chyle. Their teeth ſerve to graſp their prey, and hinder the creatures they have once catched from eſcaping again. For the ſame purpoſe, the internal cartilaginous baſis of the bronchi, and the two round bodies ſituated in the poſterior part of the jaws, have a great number of tenter-hooks fixed into them, in ſuch a manner as that any thing can eaſily get down, but is hindered from getting back. The water that is neceſſarily taken in along with their food in too great quantities to be received into their jaws in deglutition, paſſes betwixt the interſtices of the bronchi and the flap that covers them. The compreſſion of the water on the bronchi is of conſiderable uſe to the creature, as we ſhall explain by and by.

The *œſophagus* in theſe creatures is very ſhort, and ſcarcely diſtinguiſhed from their ſtomach, ſeeing their food lies almoſt equally in both. The ſtomach is of an oblong figure. There are commonly found ſmall fiſhes in the ſtomach of large ones ſtill retaining their natural form; but when touched, they melt down into a jelly. From this, and the great quantity of liquors poured into their ſtomachs, we may conclude, that digeſtion is ſolely brought about in them by the diſſolving power of a menſtruum, and that no trituration happens here.

The

The *guts* in theſe animals are very ſhort, making only three turns; the laſt of which ends in the common cloaca for the fæces, urine, and ſemen, ſituated about the middle of the inferior part of their bodies.

What I call *pancreas*, ſome give the name of *inteſtinula cæca* to: it conſiſts of a very great number of ſmall threads, like ſo many little worms, which all terminate at laſt in two larger canals, that open into the firſt gut, and pour into it a viſcous liquor much about the place where the biliary ducts enter. That kind of pancreas formed of *inteſtinula cæca* is peculiar to a certain kind of fiſhes; for the cartilaginous, broad, and flat kind, as the ſkate, ſole, flounder, &c. have a pancreas reſembling that of the former claſs of animals. Their inteſtines are connected to the back-bone by a membrane analogous to a meſentery. No lacteals have been yet obſerved.

Their *liver* is very large, of a whitiſh colour, and lies almoſt in the left-ſide wholly, and contains a great deal of fat or oil.

The *gall-bladder* is ſituated a conſiderable way from their liver; and ſends out a canal, the cyſtic duct, which joins with the hepatic duct juſt at the entry into the gut. Some fibres are ſtretched from the liver to the gall-bladder; but none that I know of have hitherto diſcovered any cavity in theſe cords: ſo in this animal it ſhould ſeem impoſſible that the bile can be carried into the gall-bladder in the ordinary way; and conſequently muſt either be ſecerned on the ſides of that ſac, or regurgitate into it from the canalis choledochus †.

The *ſpleen* is placed near the back-bone, and at a

† Here we may make the ſame remark as upon the biliary ducts of fowls, viz. that hepato-cyſtic ducts exiſt in the one as well as the other. This, for example, is very obvious in the ſalmon, where large and diſtinct ducts run from the biliary ducts of the liver, and open into the gall-bladder.

a place where it is ſubjected to an alternate preſſure from the conſtriction and dilatation of the air-bag, which is ſituated in the neighbourhood. Since, in all the different animals we have diſſected, we find the ſpleen attached to ſomewhat that may give it a conquaſſation; as in the human ſubject and quadrupeds, it is contiguous to the diaphragm; in fowls, it is placed betwixt the backbone, the liver, and ſtomach; in fiſhes, it lies on the ſaccus aërius: and ſince we find it ſo well ſerved with blood-veſſels, and all its blood returning into the liver; we muſt not conclude the ſpleen to be an *inutile pondus*, only to ſerve as a balance to the animal *pro æquilibrio*, but particularly deſigned for preparing the blood to the liver.

The only *organs* of *generation* in this animal are two bags ſituated in the abdomen uniting near the podex. Theſe in the male are filled with a whitiſh firm ſubſtance called the *milt*; and in the female with an infinite number of little ova cluſtered together, of a reddiſh yellow colour, called the *roe*. Both theſe at ſpawning-time we find very much diſtended; whereas at another time the male organs can ſcarce be diſtinguiſhed from the female; nor is there any proper inſtrument in the male for throwing the ſeed into the organs of the female, as in other creatures. I ſhall not take upon me to determine the way whereby the female ſperm is impregnated; but we find that the ſpawn of frogs conſiſts in the ſmall ſpecks wrapped up in a whitiſh glutinous liquor; theſe ſpecks are the rudiments of the young frogs, which are nouriſhed in that liquor till they are able to go in ſearch of their food. In the ſame way, the ova of fiſhes are thrown out and depoſited in the ſand, the male being for the moſt part ready to impregnate them, and they are incubated by the heat of the ſun. It is curious enough

enough to remark with what care they ſeek for a proper place to depoſit their ova, by ſwimming to the ſhallow, where they can better enjoy the ſun's rays, and ſhun the large jaws of other fiſhes. The river-fiſhes, again, ſpawn in ſome creek free from the hazard of the impetuous ſtream. But whether this mixture be brought about in fiſhes by a ſimple application of the genitals to each other, or if both of them throw out their liquors at the ſame time in one place, and thus bring about the deſired mixture, it is not eaſy to determine; the latter, I think, ſeems moſt probable. Theſe creatures are ſo ſhy, that we cannot eaſily get to obſerve their way of copulation, and are conſequently but little aquainted with their natural hiſtory. Frogs, it is very evident, do not copulate; at leaſt no farther than to allow both ſexes an opportunity of throwing their ſperm. Early in the ſpring the male is found for ſeveral days in cloſe contact upon the back of the female, with his fore-legs round her body in ſuch a manner that makes it very diffcult to ſeparate them, but there is no communication. At this time the female lays her ſpawn in ſome place that is moſt ſecure, while the male emits his ſperm upon the female ſpawn.

After raiſing up the black peritoneum in fiſhes, there comes in view an oblong white membranous bag, in which there is nothing contained but a quantity of elaſtic air. This is the *ſwimming-bladder*: it lies cloſe to the back-bone; and has a pretty ſtrong muſcular coat, whereby it can contract itſelf. By contracting this bag, and condenſing the air within it, they can make the muſcles ſpecifically heavier than water, and ſo readily fall to the bottom; whereas the muſcular fibres ceaſing to act, the air is again dilated, and they become ſpecifically lighter than water, and ſo ſwim above. According to the different degrees of contraction and

dilatation of this bladder, they can keep higher or lower in the water at pleaſure. Hence flounders, ſoles, raia or ſkate, and ſuch other fiſhes as want this ſac, are found always groveling at the bottom of the water: it is owing to this that dead fiſhes (unleſs this membrane has been previouſly broke) are found ſwimming a-top, the muſcular fibres then ceaſing to act, and that with their bellies uppermoſt; for the back-bone cannot yield, and the diſtended ſac is protruded into the abdomen, and the back is conſequently heavieſt at its upper part, according to their poſture. There is here placed a glandular ſubſtance, containing a good quantity of red blood; and it is very probable that the air contained in the ſwimming-bladder, is derived from this ſubſtance. From the anterior part of the bag go out two *proceſſes* or *appendices*, which, according to the gentlemen of the French academy, terminate in their fauces: In a variety of other fiſhes we find communications with ſome parts of the alimentary canal, particularly the œſophagus and ſtomach. The ſalmon has an opening from the fore-end of the air-bag into the œſophagus, which is ſurrounded by a kind of muſcular fibres. The herring has a funnel-like paſſage leading from the bottom of the ſtomach into the air-bag; but it is not determined whether the air enters the air-bag by this opening, or comes out by it: the latter, however, ſeems to be the more probable opinion, as the glandular body is found in all fiſhes, whereas there are ſeveral without this paſſage of communication. But in ſome fiſhes, as the cod and haddock, I never could find out this communication, either by tracing them, pouring in mercury or water, &c. I put, it is true, a probe through them; but then with the ſame ſtrength I could have put it through the ſides of the proceſſes.

At the ſuperior part of this bag there are other red-

red-coloured bodies of a glandular nature, which are connected with the kidneys. From them the *ureters* go down to their inſertion in the *veſica urinaria*, which lies in the lower part of the abdomen; and the urethra is there produced, which terminates in the podex.

Theſe laſt-mentioned parts have not hitherto been obſerved in ſome ſpecies of fiſhes; whence authors to haſtily denied them in all. Theſe creatures have a *membranous diaphragm*, which forms a ſac in which the heart is contained. It is very tenſe, and almoſt perpendicular to the vertebræ.

The *heart* is of a triangular form, with its baſe downwards, and its apex uppermoſt; which ſituation it has becauſe of the *branchiæ*. It has but one *auricle* and one *ventricle*, becauſe they want lungs, and one great artery. The ſize of the auricle and that of the ventricle are much the ſame; the artery ſends out numberleſs branches to the branchiæ or gills. And what is rather curious, this artery, inſtead of ſupporting all parts as in the frog, is diſtributed entirely upon the gills; every branch terminating there, and becoming ſo extremely ſmall as at laſt to eſcape the naked eye.

The *branchiæ* lie in two large ſlits at each ſide of their heads, and ſeem to be all they have that bears any analogy to lungs. Their form is ſemicircular; they have a vaſt number of red fibrillæ ſtanding out on each ſide of them like a fringe, and very much reſemble the vane of a feather. Theſe branchiæ are perpetually ſubjected to an alternate motion and preſſure from the water; and we may here remark, that we have not found any red blood but in places ſubjected to this alternate preſſure. This obſervation will help us in explaining the action of the lungs upon the blood. Over theſe gills there is a large flap, allowing a communication externally by which the water

they are obliged to take into their mouths with their food finds an exit without paſſing into their ſtomach: it is owing to theſe flaps coming ſo far down that the heart is ſaid commonly to be ſituated in their heads. The blood is collected again from the gills by a vaſt number of ſmall veins, ſomewhat in the ſame manner as in our pulmonary vein; but inſtead of going back to the heart a ſecond time, they immedately unite, and form an aorta deſcendens without the intervention of an auricle and ventricle. Hence a young anatomiſt may be puzzled to find out the power by which the blood is propelled from the gills to the different parts of the body; but the difficulty will be conſiderably leſſened when we conſider the manner in which the blood is carried through the liver from thé inteſtines in man and quadrupeds. The aorta in fiſhes ſends off branches which ſupply all the parts of the body excepting the gills. From the extremity of thoſe branches the blood returns to the heart ſomewhat in the ſame manner as in the former claſs of animals; only there are two inferior venæ cavæ, whereas the former has but one.

Abſorbent Syſtem in Fiſhes. We ſhall take the Haddock as a general example: for the other fiſhes, particularly thoſe of the ſame ſhape, will be found in general to agree with it.

On the middle of the belly of a haddock, immediately below the outer ſkin, a lymphatic veſſel runs upwards from the anus, and receives branches from the parietes of the belly, and from the fin below the anus: near the head this lymphatic paſſes between the two pectoral fins; and having got above them, it receives their lymphatics. It then goes under the ſymphyſis of the two bones which form the thorax, where it opens into a net-work of very large lymphatics, which lie cloſe

to

to the pericardium, and almoſt entirely ſurrounds the heart. This net-work, beſides that part of it behind the heart, has a large lymphatic on each ſide, which receives lymphatics from the kidney, runs upon the bone of the thorax backwards, and when it has got as far as the middle of that bone, it ſends off a large branch from its inſide to join the thoracic duct. After detaching this branch, it is joined by the lymphatics of the thoracic fins, and ſoon after by a lymphatic which runs upon the ſide of the fiſh. It is formed of branches, which give it a beautiful penniform appearance.

Beſides theſe branches, there is another ſet deeper which accompanies the ribs. After the large lymphatic has been joined by the above-mentioned veſſels, it receives lymphatics from the gills, orbit, noſe, and mouth. A little below the orbit, another net-work appears, conſiſting in part of the veſſels above-deſcribed, and of the thoracic duct. This net-work is very complete, ſome of its veſſels lie on each ſide of the muſcles of the gills; and from its internal part, a trunk is ſent out which terminates in the jugular vein.

The lacteals run on each ſide of the meſenteric arteries, anaſtomoſing frequently acroſs thoſe veſſels. The receptaculum into which they enter is very large, in proportion to them; and conſiſts at its lower part of two branches, of which one lies between the duodenum and ſtomach, and runs a little way upon the pancreas, receiving the lymphatics of the liver, pancreas, thoſe of the lower part of the ſtomach, and the lacteals from the greateſt part of the ſmall inteſtines. The other branch of the receptaculum, receives the lymphatics from the reſt of the alimentary canal. The receptaculum formed by theſe two branches lies on the right ſide of the upper part of the ſtomach, and is joined by ſome lymphatics in that

part, and alſo by ſome from the ſound and gall-bladder, which in this fiſh adheres to the receptaculum. This thoracic duct takes its riſe from the receptaculum, and lies on the right ſide of the œſophagus, receiving lymphatics from that part; and running up about half an inch, it divides into two ducts, one of which paſſes over the œſophagus to the left ſide, and the other goes ſtreight upon the right-ſide, paſſes by the upper part of the kidney, from which it receives ſome ſmall branches, and ſoon afterwards is joined by a branch from the large lymphatic that lies above the bone of the thorax, as formerly mentioned: near this part, it likewiſe ſends off a branch to join the duct of the oppoſite ſide; and then, a little higher, is joined by thoſe large lymphatics from the upper part of the gills, and from the fauces.

The thoracic duct, after being joined by theſe veſſels, communicates with the net-work near the orbit, where its lymph is mixed with that of the lymphatics from the poſterior part of the gills, and from the ſuperior fins, belly, &c. and then from this net-work, a veſſel goes into the jugular vein juſt below the orbit. This laſt veſſel, which may be called the termination of the whole ſyſtem, is very ſmall in proportion to the net-work from which it riſes; and indeed the lymphatics of the part are ſo large, as to exceed by far the ſize of the ſanguiferous veſſels.

The thoracic duct from the left ſide, having paſſed under the œſophagus from the right, runs on the inſide of the vena cava of the left-ſide, receives a branch from its fellow of the oppoſite ſide, and joins the large lymphatics which lie on the left-ſide of the pericardium, and a part of thoſe which lie behind the heart; and afterwards makes, together with the lymphatics from the gills, upper fins, and ſide of the fiſh, a net-work, from which a veſſel paſſes into the jugular vein of this ſide. In

a word, the the lymphatics of the left-ſide agree exactly with thoſe of the right-ſide above deſcribed. Another part of the ſyſtem is deeper ſeated, lying between the roots of the ſpinal proceſſes of the back-bone. This part conſiſts of a large trunk that begins from the lower part of the fiſh, and as it aſcends receives branches from the dorſal fins and adjacent parts of the body. It goes up near the head, and ſends a branch to each thoracic duct near its origin.

The *brain* in fiſhes are formed pretty much in the ſame way as that of fowls; only we may obſerve, that the poſterior lobes bear a greater proportion to the anterior.

Their organ of *ſmelling* is large; and they have a power of contracting and dilating the entry into their noſe as they have occaſion. It ſeems to be moſtly by their acute ſmell that they diſcover their food: for their tongue ſeems not to have been deſigned for a very nice ſenſation, being of a pretty firm cartilaginous ſubſtance; and common experiment evinces, that their ſight is not of ſo much uſe to them as their ſmell in ſearching for their nouriſhment. If you throw a freſh worm into the water, a fiſh ſhall diſtinguiſh it at a conſiderable diſtance; and that this not done by the eye, is plain from obſerving, that after the ſame worm has been a conſiderable time in the water and loſt its ſmell, no fiſhes will come near it: but if you take out the bait, and make ſeveral little inciſions into it, ſo as to let out more of the odoriferous effluvia, it ſhall have the ſame effect as formerly. Now it is certain, had the creatures diſcovered this bait with their eyes, they would have come equally to it in both caſes. In conſequence of their ſmell being the principal means they have of diſcovering their food, we may frequently obſerve their allowing themſelves to be carried down with the ſtream, that they may aſcend again leiſurely

gainſt

againſt the current of the water; thus the odoriferous particles ſwimming in that medium, being applied more forcibly to their ſmelling organs, produce a ſtronger ſenſation.

The *optic nerves* in theſe animals are not confounded with one another in their middle progreſs betwixt their origin and the orbit, but the one paſſes over the other without any communication; ſo that the nerve that comes from the left ſide of the brain goes diſtinctly to the right eye, and *vice verſa*.

Indeed it would ſeem not to be neceſſary for the optic nerves of fiſhes to have the ſame kind of connection with each other as thoſe of man have: for their eyes are not placed in the fore-part, but in the ſides of their head; and of conſequence, they cannot ſo conveniently look at any object with both eyes at the ſame time.

The *lens cryſtallina* is here a complete ſphere, and more denſe than in terreſtrial animals, that the rays of light coming from water might be ſufficiently refracted.

As fiſhes are continually expoſed to injuries in the uncertain element they live in, and as they are in perpetual danger of becoming a prey to the larger ones, it was neceſſary their eyes ſhould never be ſhut; and as the cornea is ſufficiently waſhed by the element they live in, they are not provided with palpebræ: but then, as in the current itſelf the eye muſt be expoſed to ſeveral injuries, there was a neceſſity it ſhould be ſufficiently defended; which in effect it is by a firm pellucid membrane that ſeems to be a continuation of the cuticula, being ſtretched over here. The epidermis is very proper for this purpoſe, as being inſenſible, and deſtitute of veſſels, and conſequently not liable to obſtructions, or, by that means, of becoming opake. In the eye of the ſkate tribe, there is a digited curtain which hangs over the pupil, and may ſhut out the light when

when the animal reſts, and it is ſimilar to the tunica adnata of other animals.

Ear of Fiſhes. Although it was formerly much doubted whether fiſhes poſſeſſed a ſenſe of hearing, yet there can be little doubt of it now; ſince it is found that they have a complete organ of hearing as well as other animals, and likewiſe as the water in which they live is proved to be a good medium. Fiſhes, particularly of the ſkate kind, have a bag at ſome diſtance behind the eyes, which contains a fluid and a ſoft cretaceous ſubſtance, and ſupplies the place of veſtibule and cochlea. There is a nerve diſtributed upon it, ſimilar to the poſteomollis in man. They have ſemicircular canals, which are filled with a fluid, and communicates with the bag: they have likewiſe, as the preſent profeſſor of anatomy here has lately diſcovered, a meatus externus, which leads to the internal ear. The cod fiſh, and others of the ſame ſhape, have an organ of hearing ſomewhat ſimilar to the former; but inſtead of a ſoft ſubſtance contained in the bag, there is a hard cretaceous ſtone.

The ANATOMY of INSECTS.

AS inſects and worms are ſo exceedingly numerous, it would be endleſs to examine all the different kinds, nor would it ſerve any uſeful purpoſe to the anatomiſt. We ſhall therefore be content with making a few general obſervations, and theſe chiefly on the ſtructure of their body; leaving the variety of their colour, ſhape, &c. to the naturaliſt. Inſects differ from the former claſſes, by their bodies being covered with a hard cruſt or ſcale, by their having feelers or antennæ ariſing from their head, and many of them breathing the air through lateral pores. As to the ſhape of their bodies, though it ſomewhat differs from that of birds,

birds, being in general not ſo ſharp before to cut and make way through the air, yet it is well adapted to their manner of life. The baſe of their bodies is not formed of bone, as in many other animals, but the hard external covering ſerves them for ſkin and bone at the ſame time. Their feelers, beſide the uſe of cleaning their eyes, are a guard to them in their walk or flight. Their legs and wings are well fitted for their intended ſervice; but the latter vary ſo much in different inſects, that from them naturaliſts have given names to the ſeveral orders of the claſs. As, firſt, the

COLEOPTERA, or beetle tribe, which have a cruſtaceous elytra or ſhell, that ſhuts together, and forms a longitudinal ſuture down their back.

HÆMIPTERA—as in cimex, cockroach, bug, &c. which have the upper wings half cruſtaceous, and half membranaceous; not divided by a longitudinal ſuture, but incumbent on each other.

LEPIDOPTERA—as the butterfly, have four wings, covered with fine ſcales in the form of powder.

NEUROPTERA—as the dragon-fly, ſpring-fly, &c. have four membranaceous tranſparent naked wings, generally reticulated.

HYMENOPTERA—as waſps, bees, &c. have four membranaceous wings, and a tail furniſhed with a ſting.

DIPTERA—as the common houſe-fly, have only two wings.

APTERA—as the lobſter, crab, ſcorpion, ſpider, &c. have no wings.

The ſtructure of the EYE in many inſects is a moſt curious piece of mechaniſm. The outer part is remarkably hard, to guard againſt injuries; and has commonly a reticular appearance, or the whole may be looked upon as an aſſemblage of ſmaller eyes;

eyes; but whether they ſee objects multiplied before them, has not yet been determined.

Linnæus, and ſeveral others following him, deny the exiſtence of a BRAIN in theſe creatures. But it is certain, that at leaſt a number of the larger kinds, as the lobſter, crab, &c. have a ſoft ſubſtance ſimilar to the brain, from which the optic and other nerves take their riſe; beſides, when this ſubſtance is irritated, the animal is thrown into convulſions: hence we would conclude, that inſects have a brain as well as the former claſſes, altho' this is ſmaller in proportion to their bodies.

They have a STOMACH, and other organs of digeſtion; and it is curious, that in ſome, as the lobſter, the teeth are found in the ſtomach.

They have a HEART and blood-veſſels, and circulation is carried on in them ſomewhat as in the former claſs: but the blood is without red globules; or, as naturaliſts ſpeak, is colourleſs. In the lobſter, and others of the larger kinds, when a piece of the ſhell is broken, the pulſation of the heart is ſeen diſtinctly, and that ſometimes for ſeveral hours after it has been laid bare.

LUNGS. The exiſtence of theſe by ſome has been denied. But late experiments and obſervations ſhow, that no ſpecies want them, or at leaſt ſomething ſimilar to them; and in many inſects, they are larger in proportion than in other animals: in moſt of them, they lie on or near the ſurface of their body; and ſend out lateral pores or tracheæ, by which, if the animal is beſmeared with oil, it is inſtantly ſuffocated.

GENERATION. Many have imagined that the generality of inſects were merely the production of putrefaction, becauſe they have been obſerved to ariſe from putrefied ſubſtances: but a contrary opinion is now more generally adopted; and it is pretty certain, that if putrid bodies be ſhut up in a cloſe veſſel, no inſects are ever generated unleſs

their

their ova have been originally depoſited there. They lay their eggs in places moſt convenient for the nouriſhment of their young; ſome in water, others in fleſh; ſome in fruit and leaves; while others make neſts in the earth or in wood, and ſometimes even in the hardeſt ſtone. The eggs of all inſects firſt become worms or nymphæ; from which they are changed into aureliæ, ſo named from their being incloſed in a caſe; and theſe dying, or ſeeming to die, a fly or butterfly ſucceeds.

IN-

CORRECTIONS.

Page, line.

15. 22. *For* preſerved, *read* perceived.
17. end. *For* ſit down on all fours, *read* walk on all fours.
18. 14. *For* rolls, *read* lolls.
22. 20. *For* internal, *read* inteſtinal.
— end. *For* part in other animals, *read* part in this and ſome other animals.
23. 11. *For* paunches, *read* pouches.
— 12. *After* mucus, *add* of a yellow colour.
24. 4. *For* diſcoverer *read* diſcoverers.
— 25. *For* half an [illegible] *read* an inch and half.
— 26. *For* below the [illegible], *read* below the ductus communis.
32. 29. *For* extended, *read* extracted.
35. near end. *For* faculty, *read* facility.
39. end. *For* preſt, *read* paſs.
40. 5. *For* under-hooks, *read* tenter-hooks.
41. 18. *For* proper, *read* peculiar.
43. 23. *For* globule, *read* globe.
44. 27. *For* obſcured, *read* abſorbed.
45. 13. *For* brains, *read* brain.
— end. *For* to be on either ſide, *read* to lie on either ſide.
46. 17. *For* proceſſus mamillaris, *read* proceſſus mamillares.
71. 17. *For* ſmalleſt, *read* largeſt.
72. 20. *For* longer, *read* larger.
73. 5. *For* arterioſus, *read* canalis arterioſus.
— near end. *For* one-third, *read* two-thirds.
74. 10. *For* auricle, *read* right auricle.
83. end. *For* external, *read* internal.
86. near end. *For* larger and much longer, *read* longer.
87. 26. *For* it almoſt, *read* the greateſt part of it.
211. 35. *For* ſtenhill, *read* ſtannel.
221. near end. *For* the muſcles, *read* their bodies.
227. 21. *For* experiment, *read* experience.

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